FILED
11/01/22
04:59 PM
R2005003

BEFORE THE PUBLIC UTILITIES COMMISSION OF THE STATE OF CALIFORNIA

Order Instituting Rulemaking to Continue Electric Integrated Resource Planning and Related Procurement Processes.	R.20-05-003 (Filed May 7, 2020)

CLEANPOWERSF 2022 INTEGRATED RESOURCE PLAN COMPLIANCE FILING

(PUBLIC VERSION)

(Confidential information in Appendices redacted)

DAVID CHIU
City Attorney
THERESA L. MUELLER
WILLIAM ROSTOV
Deputy City Attorneys

Attorneys for:
CITY AND COUNTY OF SAN FRANCISCO
1 Dr. Carlton B. Goodlett Place, Room 234
San Francisco, CA 94102-4682
Telephone: (415) 554-4700
Facsimile: (415) 554-4763
Email: william.rostov@sfcityatty.org

Dated: November 1, 2022

In compliance with California Public Utilities Commission (CPUC) Decision (D.) 22-02-004 (*Decision Adopting 2021 Preferred System Plan*), issued on February 15, 2022, CleanPowerSF hereby files its 2022 Integrated Resource Plan Compliance Filing. The *CleanPowerSF 2022 Integrated Resource Plan* is attached. CleanPowerSF appreciates the opportunity to participate in the CPUC's planning process, support statewide electric reliability, and contribute to achieving California's greenhouse gas reduction goals for the electric sector.

Dated: November 1, 2022

Respectfully submitted,

DAVID CHIU
City Attorney
THERESA L. MUELLER
Chief Energy and Telecommunications Deputy
WILLIAM ROSTOV
Deputy City Attorney

By: */s/William Rostov*
WILLIAM ROSTOV

Attorneys for
CITY AND COUNTY OF SAN FRANCISCO
City Hall Room 234
1 Dr. Carlton B. Goodlett Place
San Francisco, California 94102-4682
Telephone: (415) 554-4700
E-mail: william.rostov@sfcityatty.org

Standard LSE Plan

CLEANPOWERSF

2022 INTEGRATED RESOURCE PLAN

NOVEMBER 1, 2022

Table of Contents

I. Executive Summary

The City and County of San Francisco (City or San Francisco) has long championed clean energy. Today, San Francisco is motivated by climate concerns to develop policies and programs that improve climate outcomes. The City Charter makes the San Francisco Public Utilities Commission (SFPUC) responsible for managing energy supplies.[1] CleanPowerSF is the City's Community Choice Aggregation (CCA) program operated by the SFPUC.

When it launched CleanPowerSF, the SFPUC adopted the following goals for the development and operation of the program:

1) Provide affordable and reliable service;
2) Offer cleaner energy alternatives;
3) Invest in local renewable projects and jobs; and
4) Ensure long-term rate and financial stability.

This Integrated Resource Plan (IRP) will guide CleanPowerSF's resource development and procurement activities for achieving its abovementioned program goals. It also fulfills CleanPowerSF's obligation to prepare and file an IRP for review by the California Public Utilities Commission (CPUC). This IRP was approved by the five member San Francisco Public Utilities Commission for submission to the CPUC at their October 24, 2022 meeting.

CleanPowerSF serves more than 380,000 customer accounts and provides San Francisco with an electricity supply from its default "Green" product that is at least 50% Renewables Portfolio Standard (RPS)-eligible. Additionally, CleanPowerSF offers "SuperGreen", a 100% RPS-eligible electricity supply, that is available to customers for a small additional cost. The SFPUC has been tasked to provide San Franciscans with a 100% renewable and/or GHG-free electricity supply by 2025.[2] The power supply portfolio scenarios CleanPowerSF analyzed in this IRP address this goal.

To prepare this IRP CleanPowerSF modeled four power supply portfolio scenarios, which are summarized in Table 1.

[1] San Francisco Charter § 4.112(d).

[2] San Francisco Environment Code § 902(b)(3), available at https://codelibrary.amlegal.com/codes/san_francisco/latest/sf_environment/0-0-0-928 [Accessed on 10/19/2022]

Table 1 CleanPowerSF Modeled Portfolios

	NAME	GHG TARGET (MMT)	GOAL ACHIEVED	DATE GOAL ACHIEVED BY
Conforming Portfolios	**Base Case**	25	100% renewable and/or GHG-free product content.	2025
	Time Coincident Case	25	100% renewable and/or GHG-free product content, all energy generation meets ≥90% of customer demand on an hour-by-hour basis with no system power purchases between 5-10pm.	2030
Alternative Portfolios	**Climate Action Plan Case** (also referred to as Mayor's EV and Building Electrification Targets Met Case)	25	100% renewable and/or GHG-free product content, GHG emission-free passenger vehicle trips originating in, ending in, or passing through San Francisco by 2040 and decarbonization of existing buildings by 2040.	2040
	Local Resource Procurement	25	100% renewable and/or GHG-free product content and 50% of retail load met by local resource generation.	2030

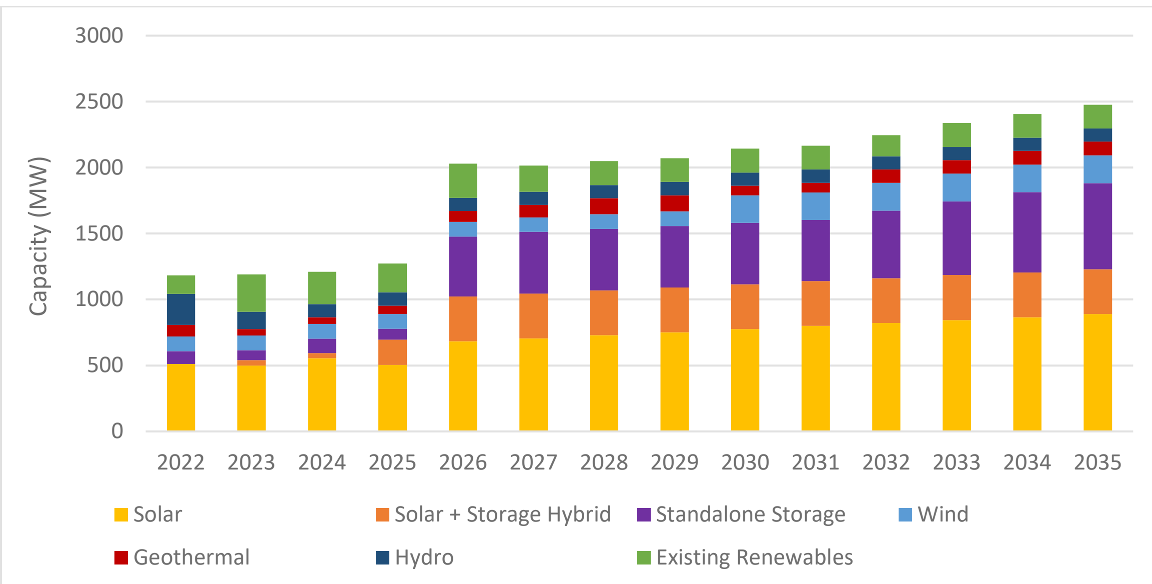
CleanPowerSF submits one Preferred Conforming Portfolio because the Preferred Conforming Portfolio has GHG emissions below CleanPowerSF's "proportional share of both the 2030 30 million metric tons (MMT) benchmark and the 2035 25 MMT benchmark."[3]

[3] R.20-05-003, *Administrative Law Judge's Ruling Finalizing Load Forecasts and Greenhouse Gas Emissions Benchmarks for 2022 Integrated Resource Plan Filings*, June 15, 2022 ("ALJ Ruling on Forecasts and GHG Benchmarks"), p. 12.

After evaluating each of the portfolios modeled on the basis of their performance against CleanPowerSF's program goals, CleanPowerSF hereby submits the Time Coincident Case as its Preferred Conforming Portfolio under the 30 MMT and 25 MMT scenarios. The resources selected in this case are illustrated in Figure 1. The Study Results section of this document describes CleanPowerSF's modeled portfolio results, including a summary of the Preferred Conforming Portfolio's GHG emissions and local air pollutants, impacts to disadvantaged communities, the estimated portfolio cost, contribution to system reliability, and planning considerations for high electrification scenarios, existing resources, hydro generation risk, long-duration storage, clean firm power, offshore wind, and transmission needs.

The Time Coincident Case meets CleanPowerSF's program objective of supplying customers with renewable and/or GHG-free electricity on an annual basis by 2025.[4] It was also selected as the Preferred Conforming Portfolio because it provides a diverse energy supply, meets CleanPowerSF's projected annual share of system reliability, and balances new resource builds to limit unreasonable market risk.

Figure 1: CleanPowerSF Preferred Conforming Portfolio (Time Coincident Case) Total Resource Capacity by Year



CleanPowerSF describes the activities it will pursue to meet its Preferred Conforming Portfolio targets in the Action Plan section of this document. These activities include issuing several solicitations in the near-term (end of 2022 and start of 2023). CleanPowerSF will continue to target procurement of new Bay Area solar and local storage projects on City-owned property in San Francisco and within the nine Bay Area Counties to support CleanPowerSF's program goal of investing in local renewable projects and local jobs. Additionally, CleanPowerSF will procure new in-state solar, hybrid energy storage, standalone energy storage, and geothermal resources. We will also continue to engage in joint-CCA

[4] San Francisco Environment Code § 902(b)(3).

procurement efforts, as appropriate. To implement CleanPowerSF's Preferred Conforming Portfolio, the Action Plan section of this document also describes CleanPowerSF's progress toward D.19-11-016 and D.21-06-035 procurement obligations, additional procurement actions planned across resource types, and CleanPowerSF programs that address disadvantaged communities.

The IRP is a cyclical process, and all load-serving entities (LSEs) including CCAs such as CleanPowerSF have to update their IRP every two years. CleanPowerSF will update this IRP and adapt its procurement preferences to future changes in technology, market conditions, regulatory requirements and other factors to ensure it is able to consistently offer its customers clean, reliable, and affordable electricity supply services.

II. Study Design

CleanPowerSF's long term procurement planning is guided by the goals and policies established by the City and County of San Francisco and the state's regulatory requirements for LSEs. San Francisco has adopted a citywide goal of 100% renewable and/or GHG-free electricity supply by 2025.[5]

In our 2020 IRP, CleanPowerSF's Preferred Conforming Portfolio exceeded the City's previous planning targets by five years by planning to supply customers with renewable and/or GHG-free electricity on an annual basis by 2025.[6] The annual planning targets for RPS-eligible renewable and additional renewable and/or GHG-free resources CleanPowerSF used in developing portfolios for this 2022 IRP are consistent with the 2020 IRP's Preferred Conforming Portfolio and achieve CleanPowerSF's power content goals over the 2022-2035 planning horizon, as summarized in Table 2.

[5] San Francisco Environment Code § 902(b)(3).

[6] CleanPowerSF 2020 Integrated Resources Plan Compliance Filing (Public Filing). https://sfpuc.sharefile.com/share/view/s61300b4056124fcda409799fd243d245 [accessed 10/19/2022].

Table 2 CleanPowerSF Planning Targets

POWER CONTENT GOALS	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
RPS-eligible Renewable	58%	63%	68%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
Additional Renewable and/or GHG-Free	33%	31%	28%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Total Renewable and/or GHG-free	91%	94%	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

CleanPowerSF modeled and analyzed two Conforming Portfolios to arrive at the Preferred Conforming Portfolio submitted as part of this 2022 IRP:

- **Base Case** – The Base Case portfolio models meeting the CleanPowerSF annual product content targets identified in Table 2 above, consistent with City goals.
- **Time Coincident Case** – The Time Coincident portfolio adds a time coincidence constraint to the Base Case 25 MMT discussed above. In addition to meeting the product content targets outlined in Table 2, this portfolio's generation matches ≥90% of demand on an hourly basis with no system power purchases between 5 and 10pm.

CleanPowerSF modeled the Base and Time Coincident portfolios under market conditions for a statewide 25 MMT greenhouse gas target. Differences in the underlying assumptions between the two scenarios has allowed CleanPowerSF to better understand the resource availability and cost impacts the two scenarios may have on future CleanPowerSF procurement options and costs. CleanPowerSF's Conforming Portfolios achieve emissions that are less than its proportional share of the 2035 25 MMT target and, therefore, submits only one Preferred Conforming Portfolio as part of this IRP filing.[7]

CleanPowerSF includes two additional Alternative Portfolios. The first Alternative Portfolio assumes the San Francisco Climate Action Plan's electrification goals are met, and the second Alternative Portfolio includes a higher proportion of procurement from local resources, defined as projects located within the nine counties of the San Francisco Bay Area, that meet 50% of CleanPowerSF demand with local generation by 2030. Both Alternative Portfolios are modeled with CleanPowerSF's behind-the-

[7] See ALJ Ruling on Forecasts and GHG Benchmarks, p. 12.

meter photovoltaic (BTM PV) forecast, which is significantly lower in capacity and total energy from the assumptions supplied by the CPUC and CEC.

- **Climate Action Plan Case** (also referred to as Mayor's Electric Vehicle and Building Electrification Targets Met Case) – The Climate Action Plan portfolio models the additional generation needed to accommodate 100% GHG emission-free passenger vehicle trips originating in, ending in, or passing through San Francisco and decarbonization of existing buildings, all by 2040, as described in San Francisco's 2021 Climate Action Plan.[8]
- **Local Resource Preferences Case** – The Local Resource Procurement portfolio includes a higher proportion of local resources in the resource baseline and establishes a local resource floor of 50% of energy supply by 2030.

Load Assignments for Each LSE

For this IRP analysis, CleanPowerSF used its load forecasts assigned by the CPUC.[9] The demand forecast used to develop CleanPowerSF's load assignment was derived from the 2021 Mid-Baseline – Mid Additional Achievable Energy Efficiency (AAEE) Case, in the California Energy Commission (CEC) Integrated Energy Policy Report[10] (IEPR) through 2035 as summarized in Table 3 below.

Table 3 CleanPowerSF Assigned IRP Sales Annual IEPR Forecast

CLEANPOWERSF LOAD FORECAST (GWH)	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Managed Retail Sales	2,944	2,970	2,993	3,015	3,039	3,062	3,090	3,119	3,153	3,181	3,215	3,247	3,293
Demand at the Generator Busbar	3,179	3,206	3,232	3,256	3,282	3,307	3,337	3,368	3,405	3,436	3,472	3,507	3,557

[8] San Francisco's Climate Action Plan 2021, page 41 https://sfenvironment.org/sites/default/files/cap_fulldocument_wappendix_web_220124.pdf [Accessed 10/19/2022]

[9] Administrative Law Judge's Ruling Finalizing Load Forecasts and Greenhouse Gas Emissions Benchmarks for 2022 Integrated Resource Plans: https://docs.cpuc.ca.gov/PublishedDocs/Efile/G000/M485/K625/485625915.PDF [Accessed 10/19/2022]

[10] Final 2021 IEPR available at: https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report [Accessed 10/19/22]

The 2021 Mid-Baseline – Mid AAEE forecast represents the CEC's projections for electricity demand under a mid-range economic and demographic growth across California and mid-range of additional achievable energy efficiency, which is the projected energy savings resulting from programs and efforts that are likely to occur but have no official funding or planning commitments to date. These include updates of building standards, appliance regulations, or new and expanded energy efficiency programs. Additional Achievable Fuel Substitution (AAFS) is a new load modifier introduced in the 2021 IEPR forecast and represents incremental fuel substitution not included in the baseline demand forecast but is reasonably expected to occur.[11] One example of incremental fuel substitution is the decarbonization strategy of replacing gas end uses with more efficient electric end uses.

The IEPR demand forecast represents CleanPowerSF's managed retail sales. These annual volumes are then grossed up approximately 8% each year to account for transmission and distribution losses. This is CleanPowerSF's "Demand at the Generator Busbar," which is the total demand modeled in each of the Conforming Portfolios described in this report.

CleanPowerSF opted to use a custom load, or demand shape, due to significant observed differences between the load profile in the Clean System Power (CSP) Calculator and CleanPowerSF's internal demand forecast. This discrepancy occurs because the CPUC assigned load assumes a much higher rate of behind-the-meter (BTM) solar generation for San Francisco, which impacts CleanPowerSF's load shape. Additionally, CleanPowerSF employed a custom BTM solar shape in the CSP Calculator to better reflect mid-day solar generation in San Francisco. The GHG Emissions Results section of this plan provides more detail on how the custom shapes were developed.

Required and Optional Portfolios

As authorized by the ALJ, CleanPowerSF submits the same Preferred Conforming Portfolio for both the 30 MMT and 25 MMT portfolios.[12] This portfolio was developed using CPUC provided inputs and assumptions as well as additional inputs and assumptions developed by CleanPowerSF, where allowed by the CPUC's guidelines. Both of the Conforming Portfolios achieve emissions below CleanPowerSF's assigned GHG benchmark under the 30 MMT scenario and the 25 MMT scenario and the Preferred Conforming Portfolio meets San Francisco's policy objectives to achieve a 100% renewable and/or GHG-free electricity supply.

Along with this narrative template, CleanPowerSF is submitting the same completed CPUC Resource Data Template and Clean System Power Calculator for its Preferred Conforming Portfolio under the 30 MMT and 25 MMT target as appendices to this narrative. CleanPowerSF also submits a completed CPUC Resource Data Template and Clean System Power Calculator for its Base Case Conforming Portfolio

[11] Final 2021 Integrated Energy Policy Report, Volume IV: California Energy Demand Forecast. California Energy Commission. Publication Number: CEC-1002021-001-V4. Available at: https://efiling.energy.ca.gov/GetDocument.aspx?tn=241581 [Accessed 10/13/2022]

[12] ALJ Ruling on Forecasts and GHG Benchmarks, p. 15 (Ruling Para. 2).

under the 25 MMT target, which was not selected as its Preferred Conforming Portfolio. A list of the appendices follows:

- Appendix A: 25 MMT Preferred Conforming Portfolio Resource Data Template
- Appendix B: 30 MMT Preferred Conforming Portfolio Resource Data Template
- Appendix C: 25 MMT Base Case Conforming Portfolio Resource Data Template
- Appendix D: 25 MMT Preferred Conforming Portfolio Clean System Power Calculator
- Appendix E: 30 MMT Preferred Conforming Portfolio Clean System Power Calculator
- Appendix F: 25 MMT Base Case Conforming Portfolio Clean System Power Calculator

Additionally, CleanPowerSF is submitting two Alternative Portfolios in this IRP. The Climate Action Plan Alternative Portfolio was developed using increased EV and building decarbonization load assumptions and the Local Resource Procurement Alternative Portfolio required that 50% of CleanPowerSF demand be supplied by local resources by 2030. Both Alternative Portfolios opted to use BTM PV generation inputs developed by CleanPowerSF rather than the assigned BTM PV required for Conforming Portfolio development. Both of the Alternative Portfolios achieve emissions below CleanPowerSF's assigned GHG benchmark under the 30 MMT scenario and the 25 MMT scenario and meet San Francisco's policy objectives to achieve an electricity supply with zero GHG emissions.

CleanPowerSF's Climate Action Plan Alternative Portfolio uses load inputs guided by San Francisco's transportation and building electrification goals; these are reported using the standard IEPR filing form template in Appendix G.

GHG Emissions Benchmark

CleanPowerSF was assigned a GHG emissions benchmark under both a 30 MMT and a 25 MMT statewide GHG emissions planning target for the 2035 planning year. These statewide targets represent the maximum levels of GHG emissions in 2035 that all California LSE portfolios may emit once aggregated into a statewide total. The 2035 targets were set by Administrative Law Judge's (ALJ) ruling using the straightline projection between the 2021 Preferred System Plan's (PSP) 2030 38 MMT GHG emissions planning target and the 2045 15 MMT GHG emissions planning target used in the modeling for the PSP decision.

The CPUC set CleanPowerSF's individual benchmarks using CleanPowerSF's proportional share of electricity demand in Pacific Gas & Electric Company's (PG&E) territory; the two benchmarks are included in Table 4 below. GHG emissions associated with behind-the-meter combined heat and power (BTM CHP) were netted out at the system level and were not included in CleanPowerSF's assigned GHG emissions benchmark. BTM CHP emissions, which total 4.4 MMT in 2035 for the entire electric sector, will be added to the electric sector emissions calculation by CPUC's Energy Division when it aggregates all submitted 2022 Integrated Resource Plans.[13]

[13] ALJ Ruling on Forecasts and GHG Benchmarks, pp 10-11.

Table 4 CleanPowerSF GHG Benchmarks

2035 GHG PLANNING TARGET	30 MMT	25 MMT
CleanPowerSF 2035 GHG Benchmark (MMT)	0.340	0.272

a. Objectives

Program Goals

The SFPUC adopted the following program goals for CleanPowerSF, which guide CleanPowerSF's operations and the development of this IRP.

- **Lead with Affordable and Reliable Service:** CleanPowerSF is committed to providing service that is reliable and affordable for all San Franciscans. To do so, CleanPowerSF pursues the lowest cost energy supply possible that also satisfies its other program goals. Sourcing the most affordable energy requires both execution of desirable, low-cost contracts, and strategic management of its portfolio to allow CleanPowerSF to take advantage of market opportunities, while minimizing ratepayer risk.
- **Provide Cleaner Electricity Alternatives:** A critical element of CleanPowerSF's mission is to provide cleaner energy alternatives to San Francisco. Today, CleanPowerSF offers a "Green" electricity supply product that is at least 50% RPS-eligible renewable. CleanPowerSF's second electricity supply product is called "SuperGreen" and features 100% RPS-eligible renewable energy. Consistent with San Francisco's goal, CleanPowerSF plans to supply a 100% renewable and/or GHG-free power mix by 2025.
- **Invest in Local Renewable Projects and Local Jobs:** As CleanPowerSF continues to procure additional renewables to meet its program demand, it does so with a preference for local projects, where cost-effective.
- **Provide for Long-Term Rate and Financial Stability:** CleanPowerSF manages its program and its power supply portfolio to minimize rate increases while providing for long-term financial stability of the program.

City Policies

The City policies regarding energy supply product content were developed over time:

- **Ordinance No. 81-08:** In Ordinance 81-08, the Board of Supervisors articulated the goal of having a fossil-free electric system by 2030 .[14]
- **Resolution 349-11:** In this Resolution, the Board of Supervisors approved San Francisco's 2011 Updated Electricity Resource Plan calling for a "City-wide plan to meet San Francisco's zero-GHG goal by 2030" including through the development of Community Choice Aggregation.[15]
- **Resolution 17-0102:** On Earth Day 2017, the mayor of San Francisco announced a new City goal of a 50% renewable electricity supply by 2020.[16] This goal was adopted for the CleanPowerSF program in San Francisco Public Utilities Commission (SFPUC) Resolution 17-0102, which directs that "renewable energy content of the Green (default) product from 35% to 50% by the end of 2020, or sooner if possible."[17]
- **Ordinance No. 117-21:** On Earth Day 2021, the mayor of San Francisco announced that CleanPowerSF will provide all customers with 100% renewable electricity by 2025.[18] Ordinance No. 117-21 set climate action goals for San Francisco, including the Mayor's renewable electricity target.[19]

Using the targets established by the City's policies, CleanPowerSF developed the annual product content targets for its Green product portfolio shown in Table 5.

[14] San Francisco Ordinance No. 81-08, (May 13, 2008) sec. 907, available at: https://www.sfbos.org/ftp/uploadedfiles/bdsupvrs/ordinances08/o0081-08.pdf [Accessed 10/10/2022] (this goal was superseded by subsequent ordinance. (see fn. 18.) San Francisco's current Climate Action Goals are listed in Environment Code § 902.)

[15] San Francisco Resolution No. 349-11 (July 25, 2011) available at https://sfbos.org/ftp/uploadedfiles/bdsupvrs/resolutions11/r0349-11.pdf [Accessed 10/10/2022] San Francisco's current Climate Action Goals are listed in Environment Code § 902.)

[16] City and County of San Francisco Office of the Mayor. *Mayor Lee Announces San Francisco Exceeds New Greenhouse Gas Emissions Reduction Milestone* (April 19, 2017*).* https://sfmayor.org/article/mayor-lee-announces-san-francisco-exceeds-new-greenhouse-gas-emissions-reduction-milestone [Accessed 10/12/2022]

[17] SFPUC Resolution 17-0102 (May 9, 2017) available at: https://sfpuc.sharefile.com/share/view/s885b58732ca4f709 [Accessed on 10/10/2022]

[18] City and County of San Francisco Office of the Mayor. *Mayor London Breed Announces New Climate Commitments and Environmental Successes* (April 22, 2021*).* https://sfmayor.org/article/mayor-london-breed-announces-new-climate-commitments-and-environmental-successes [Accessed 10/12/2022]

[19] San Francisco Ordinance No. 117-21 (July 27, 2022) sec. 902, available at*:* https://sfbos.org/sites/default/files/o0117-21.pdf [Accessed 10/10/2022]

Table 5 CleanPowerSF Green Product RPS-eligible Renewable and GHG-Free Power Content Goals

POWER CONTENT GOALS	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
RPS-eligible Renewable	63%	68%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%	73%
Additional Renewable and/or GHG-Free	31%	28%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%	27%
Total Renewable and/or GHG-Free	94%	97%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

To support further development of its portfolio, CleanPowerSF engaged consultants to develop modeling inputs, including costs and generation profiles for local resource options, and to develop portfolios under a range of different scenarios addressing the 2022 to 2035 time horizon. Guided by the adopted 2021 Preferred System Portfolio, CleanPowerSF and its consultants sought to determine the volume of existing renewable and GHG-Free energy resources it could reasonably procure as well as the most cost-effective new resource buildout for its portfolios. The overarching goal of the analysis was to identify the lowest cost portfolio mix that could meet the state's RPS requirements, the City's long-term electricity supply goals, and contribute sufficiently to maintaining systemwide reliability.

b. Methodology

i. Modeling Tool(s)

CleanPowerSF engaged Siemens PTI as a consultant to support its IRP modeling. For CleanPowerSF's 2022 IRP, Siemens PTI used version 14.0.1057 of the Aurora production cost modeling software from vendor Energy Exemplar.[20] Siemens PTI tools fully integrate risk assessment into long-term energy and resource planning. The core component of our risk analysis system is the AURORAxmp® power dispatch and market price model, developed by EPIS and used extensively in the western U.S.

AURORA is a chronological unit commitment model which works to simulate the economic dispatch of power plants within a competitive market framework. The model uses a mixed integer linear programming (MIP) approach to capture details of power plant and transmission network operations, while observing real world constraints. Constraints include items such as emission reduction targets,

[20] Further product information on Aurora version 14.0.1057 can be found on Energy Exemplar's website here: https://energyexemplar.com/solutions/aurora/ [Accessed 10/13/2022].

transmission and plant operating limits, renewable energy availability and mandatory portfolio targets. AURORA is widely used by electric utilities, consulting agencies, and other stakeholders for the purpose of forecasting generator performance and economics, developing IRPs, forecasting power market prices, assessing detailed impacts of regulatory and market changes impacting the electric power industry, and to generate financially optimized generating portfolios. The model can assess the potential performance and capital costs of existing and prospective generation technologies and resources, and make resource addition and retirement decisions for economic, system reliability, and policy compliance reasons on a utility system.

The CPUC used RESOLVE to develop the 2021 Preferred System Plan, which identifies the new resources needed to meet the GHG emissions planning constraint. CPUC uses SERVM as a separate tool to examine system reliability and simulate production cost. AURORA is both a long-term capacity expansion (LTCE) tool and a production cost model. AURORA and RESOLVE both optimize dispatch for a system under a given set of inputs. RESOLVE is a linear optimization model, which assesses dispatch based on representative days over a defined forecast horizon. AURORA differs in that it is a mixed integer program and hourly chronological dispatch simulation. Both RESOLVE and AURORA identify the optimal resources to meet needs based on the technology options offered including generation and storage. Both models also allow for the incorporation of different types of market and portfolio constraints including renewable generation, carbon emissions, reserve margin, and timing of new build requirements.

Table 6: Comparison of AURORA, RESOLVE, and SERVM Functionality

RESOLVE/SERVM	AURORA
Groups resources into categories with similar operational characteristics (e.g., nuclear, coal, gas CCGT, gas peaker, renewables) and models them collectively.	Models each generator independently.
Linearized unit commitment where the commitment variable for each class of generators is a continuous variable rather than an integer variable.	Models the operating cost and performance parameters on a plant-level basis, where the optimization method uses a MIP to determine unit commitment.
Run for a sampled 37 days in a year and only for a few years, therefore, only representative load and renewable profiles were selected to reflect system conditions.	In the LTCE process, Siemens used a sampling of 104 days and every other hour for each year of the 20-year study horizon. In the final simulation of the system, AURORA simulates plant operating and market conditions for every hour, every day, and every year of the study horizon.
Generally, focuses on a single market, reflecting high level interties and market interaction with neighboring regions.	AURORA can be set up in several different ways. For this analysis, AURORA was run for the entire Western Interconnection.

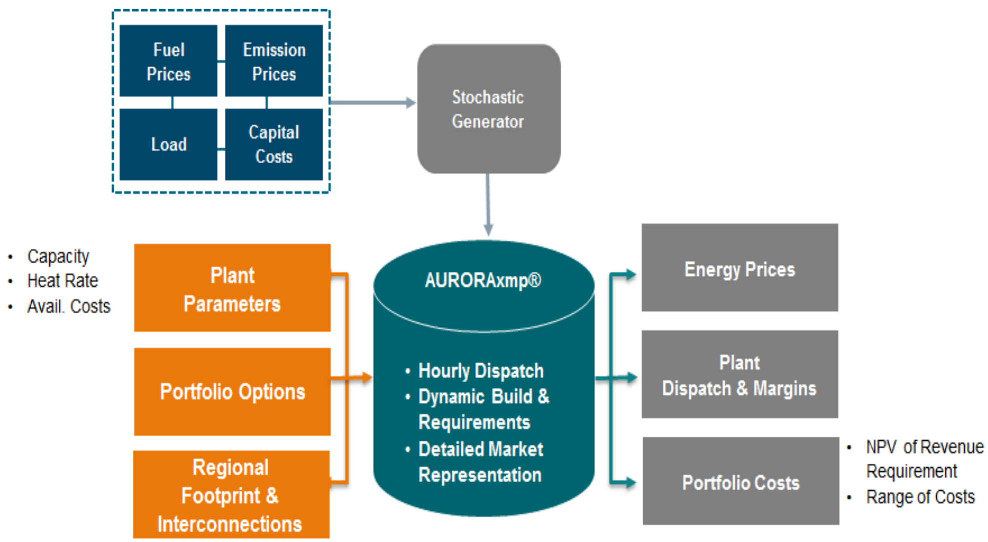
Some key features of AURORAxmp® are:

- A dispatch algorithm that is similar to other production cost models like the RESOLVE model used by the CPUC;
- A unique bidding structure that simulates market incentives for investing in plants that can cause over or under building of assets. This feature provides a distinct advantage over equilibrium models, as power markets are rarely in equilibrium;
- An ability to characterize market volatility and uncertainty in stochastic distribution representations for all fuels and the price movement correlations among these inputs;
- An ability to conduct Monte Carlo simulations generated from these distributions to generate power dispatch and market price simulations;
- Direct links to nodal transmission models for accurate representations of LMP/nodal pricing and transmission congestion;
- Accurate modeling of SO_2, NO_X, and carbon emission rate and emissions costs;
- Integrated evaluation of multiple portfolios in the context of one integrated model;
- Easy downloads to graphics packages for representing inputs and results in easy to follow and understandable graphics.

Siemens PTI simulates the generation market prices and plant dispatch for a relevant market area over the range of inputs using its power dispatch model (AURORAxmp®). This model is a sophisticated market dispatch model that has every generating station (including its characteristics, regulatory requirements and transmission links) in the United States. Inputs to the model include operating cost and performance parameters, fuel options and costs and environmental costs and parameters.

Siemens PTI deploys AURORAxmp® to simulate the economic dispatch of power plants within a competitive framework. Representations of hourly regional demand profiles and plant-level supply characteristics are included, as well as detailed assessments on the fundamental drivers of power plant dispatch within each relevant market area. A summary of the methodology with key inputs, algorithms, and outputs is shown in the Figure 2 below.

Figure 2: AURORAxmp® Methodology Schematic



There are some key similarities and differences between the Aurora model and the RESOLVE model. As indicated above, AURORA is both a production model and a LTCE optimization model. AURORA is an hourly, chronological production cost model with an integrated LTCE feature. The LTCE produces a resource expansion plan given resource options and constraints around those options. The options can include supply and demand generic resources, including energy storage, existing resources, and resources for economic retirement as desired. The full set of standard operational and cost parameters for new and existing resources are considered in the LTCE, providing a robust framework from which to evaluate different technologies with different operational (intermittent vs. baseload), cost and incentive profiles. The LTCE considers constraints such as reserve margin targets or requirements, RPS requirements, carbon limits, and operational constraints for providing ancillary services. Siemens' LTCE logic is illustrated in the figure above.

The LTCE model makes use of an iterative logic to develop a regional capacity expansion plan. At the end of any given iteration, it has the information it needs to take retirement actions on existing uneconomic resources and to select economically viable new resource options. Convergence criteria reduce the total number of resource alternatives which are considered by the LTCE model through the iterations, with a converged solution being defined as one in which system prices remain stable even with changes in resource alternatives. In other words, the solution reflects an expansion plan that is at once both economically rational and stable.

With this approach, AURORA performs an iterative future analysis where:

1. Resources that have negative going-forward value (revenue minus costs) are retired;
2. Resources with positive values are added to the system on a gradual basis, whereby a set of resources with the most positive net present value are selected from the set of new resource options and added to the study;
3. AURORA then uses the new set of resources to compute all the values again; and
4. The process of adding and retiring resources is continually repeated until the system price stabilizes, indicating that an optimal set of resources has been identified for the study.

Aurora differs in that it is an hourly chronological dispatch model. RESOLVE generally focuses on a single market, reflecting high level interties and market interaction with neighboring regions. Aurora can be set up in several different ways. Siemens PTI has developed Aurora as a national model reflecting all major zones and ISOs in the U.S. For this analysis, Aurora was run for the entire western interconnect.

Both RESOLVE and Aurora identify the optimal resources to meet needs based on the technology options offered including generation, storage and demand side resources. Both models also allow for the incorporation of different types of market and portfolio constraints including renewable generation, carbon emissions (or emission rates), reserve margin, and timing of new build requirements.

ii. Modeling Approach

As noted above, CleanPowerSF's IRP portfolios were designed to meet or exceed City and state power supply goals and were modeled to be CPUC Conforming Portfolios. To accomplish this, CleanPowerSF introduced a number of underlying assumptions, minimum requirements, and constraints to which all developed portfolios would adhere.

With the exception of local resources, CleanPowerSF's 2022 IRP inputs and resource availability assumptions reflect these from the California Public Utilities Commission's Preferred System Portfolio (CPUC's PSP). These include updates released on June 15, 2022.[21]

[21] See LSE Filing Requirement RESOLVE Results available at: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials [Accessed 9/20/2022].

The CPUC requires using their assumptions from the RESOLVE model for the base outlook but allowed LSEs to use different capital cost and financing information. CleanPowerSF elected to use capital cost and financing information developed by Siemens PTI. Key inputs include:

- Load forecasts
- Fuel costs
- Emission costs
- Technology costs
- Resource availability
- Transmission constraints
- Senate Bill 100 (SB100) increased the state's renewable portfolio standard to 60% by 2030
- GHG target for the electric sector for 2035 is 30 MMT for the first Conforming Portfolio[22]
- GHG target for the electric sector for 2035 is 25 MMT for the second Conforming Portfolio

The candidate resources' capital cost, operating cost, and levelized cost of energy used in the analysis were derived from Siemens PTI and included below for reference. Cost values were taken from a combination of resources, including, but not limited to, National Renewable Energy Laboratory, IHS Market, Energy Information Administration, American Association of Cost Engineers, and Lawrence Berkeley National Laboratory, and were adjusted to reflect investment tax credit (ITC) and production tax credit (PTC) benefits resulting from the Inflation Reduction Act of 2022.[23] Additionally, CleanPowerSF conducted extensive analysis on local project options on City-owned properties within San Francisco and the nine Bay Area counties and used those project-specific costs for local resource options in its IRP modeling. An overview of the costs used are featured in Table 7 and Table 8 below.

[22] As mentioned above, CleanPowerSF is submitting one preferred portfolio with GHG emissions below CleanPowerSF's proportional share of the 25 MMT benchmark.

[23] Resource cost assumptions were adjusted to reflect the technology neutral nature of PTCs and ITCs adopted pursuant to the Inflation Reduction Act of 2022.

Table 7: Average Resource Levelized Cost of Energy (2021$/MWh)

	2022	2025	2030	2035
Geothermal	$63	$50	$49	$53
Utility Scale Solar	$39	$40	$31	$33
Onshore Wind	$105	$40	$31	$33
Li-Ion Battery (Standalone)	$92	$93	$71	$73
Solar PV +Li-Ion Battery (Hybrid)	$62	$57	$45	$47
Offshore Wind	$171	$170	$130	$135
Flow Battery	$89	$92	$80	$52
Pacific Northwest Hydro	$76	$81	$65	$56
In-State Large Hydro	$76	$81	$65	$56

Table 8: Local Project Costs (2021$/MWh)

	IN-CITY SOLAR	IN-CITY SOLAR PV + LI-ION BATTERY (HYBRID)	9 COUNTY BAY AREA SOLAR PV + LI-ION BATTERY (HYBRID)
2-5 MW	$153-$167	$274-$384	NA
5-20 MW	NA	NA	$163-$187

CleanPowerSF used industry reports and conducted analysis to determine the incremental costs of existing renewable resources above projected energy market costs. These annual forecasts are shown in Table 9 below.

Table 9: Incremental Costs of Existing Renewable Resources (2021$/MWh)

YEAR	RENEWABLE
2022	$9.00
2023	$8.50
2024	$8.00
2025	$6.75
2026	$6.00
2027	$5.00
2028	$3.90
2029	$3.00
2030	$2.00
2031	$1.50
2032	$1.00
2033	$0.25
2034	$0.00
2035	$0.00

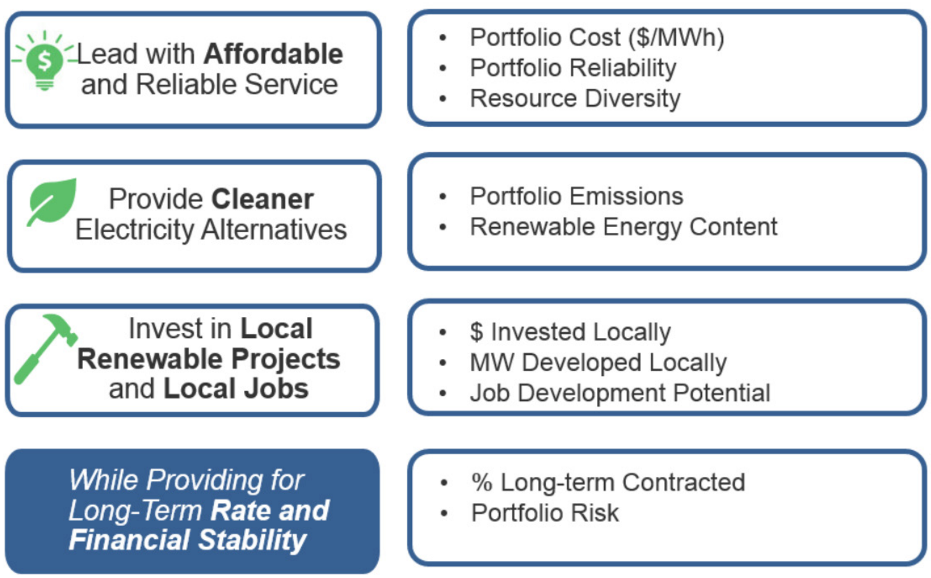
Using the cost assumptions above, CleanPowerSF's modeling approach aimed to develop the most cost-effective portfolios that also meet the following constraints. These were incorporated into the model to ensure each portfolio met CleanPowerSF environmental, cost, and local investment program goals:

- All portfolios have an RPS-eligible content of at least 73% and are 100% renewable and/or GHG-free by 2025.
- All portfolios prioritize local resources and contain 50 MW of local geothermal, 85.6 MW of local solar, and 150 MW of local battery storage.
- All portfolios meet at least 60% of CleanPowerSF's projected System Resource Adequacy Requirements with long-term renewable contracts by 2030.
- The earliest online date for new build resources not already under contract was 2026 to reflect current contracting lead times.
- A hedging constraint was applied which limited long-term contracts to 62% of contracted energy in each portfolio.
- Future purchases of large hydro were limited to CleanPowerSF's proportional share of what was included for in-state and Pacific Northwest large hydro in the CPUC's 2021 Preferred System Plan.
- Net market purchases as a percentage of total demand were not permitted to exceed 20% in all portfolios.
- The Time Coincident case does not allow for market purchases of more than 10% on an annual basis beginning in 2030.

CleanPowerSF modeled two Conforming Portfolios: CleanPowerSF's Base Case and a Time Coincident Case. The Base Case was modeled as a baseline portfolio, one which meets CleanPowerSF's established goals discussed above. The Time Coincident Case was modeled to achieve CleanPowerSF's 2025 product content goals with renewable and/or GHG-free resources that meet ≥90% of projected customer demand on an hourly basis. Additionally, CleanPowerSF modeled two Alternative Portfolios. The Climate Action Plan Case meets the additional demand projected from San Francisco's 2040 GHG emission-free passenger trips and building decarbonization targets.[24] The Local Resource Procurement Case meets 50% of energy supply with local resources by 2030.

Once the results were received, CleanPowerSF evaluated both of the portfolios using a set of metrics tied to CleanPowerSF program goals:

Figure 3: CleanPowerSF IRP Portfolio Evaluation Criteria



Climate Action Plan Alternative Portfolio

The advanced decarbonization goals of the City of San Francisco require CleanPowerSF to model a more aggressive schedule for decarbonization than that set in the Conforming Portfolio, which has led to the development of the Alternative Portfolio achieving the Mayor's EV and building electrification targets. San Francisco's Environment Code and its 2021 Climate Action Plan Update include targets to have zero emissions large commercial buildings by 2035 and all buildings zero emissions by 2040.[25] San Francisco has also passed legislation that requires (as of June 2021) all new construction to be all-

---

[24] See San Francisco Env. Code § 902(b)(2) and (5); San Francisco's Climate Action Plan 2021 (page 41) available at: https://sfenvironment.org/sites/default/files/cap_fulldocument_wappendix_web_220124.pdf [Accessed on 9/21/2022].

[25] San Francisco Environment Code § 902(b)(5). San Francisco's Climate Action Plan 2021, page 41.

electric.[26] Reflecting advanced transportation electrification goals, the Climate Action Plan Update puts forth that by 2040 100% of vehicles registered within San Francisco should be electric, achieving 25% electric vehicle registration by 2030.[27] These targets have significant implications for CleanPowerSF long term planning and procurement.

CleanPowerSF commissioned a model built to review how the achievement of the Mayor's building electrification targets is expected to impact CleanPowerSF's total demand, peak demand and associated procurement requirements in each year.[28] The model's flexibility has allowed for review of how different variables – including therms of natural gas end use demand to be removed by rate class[29], kWh-per-therm removed electrification rates by sector and subsector[30], proportion of load electrifying to CleanPowerSF service, and adoption rates – impact the increase in total and peak demand. Iterative review of different sensitivities have led to development of a "most likely" mid case annual amount of increased energy demand due to building electrification (high and low cases reflecting sensitivities run have also been developed to inform CleanPowerSF procurement risk management). The total increase in each year has been developed into an hourly profile using the building electrification shapes provided in the Clean System Power calculator, after a modification to align with the monthly distribution of natural gas consumption in San Francisco for residential and commercial sectors and weighted to represent the percent of residential vs commercial load expected to be electrifying in each year.

CleanPowerSF also developed a model to project how the achievement of the Mayor's vehicle electrification targets is expected to impact CleanPowerSF total demand and peak demand. The model separately calculates electricity usage estimates for an increasing amount of private electric vehicles and commercial electric vehicles. The private vehicle forecast (all fuels) derives three categories of private vehicle sales[31] calculated separately based on U.S. light duty vehicle (LDV) sales data and historic purchasing patterns. The resulting sales were multiplied by the average miles San Francisco vehicles are

---

[26] San Francisco Building Code §106A.1.17.1.

[27] San Francisco Environment Code § 902(b)(2); San Francisco's Climate Action Plan 2021, page 41.

[28] The adoption rate of the Mayor's Targets reflects the expected rates of building redevelopment and retrofit provided in the San Francisco's Climate Action Plan 2021 (page 65) and discussions with the San Francisco Department of Environment.

[29] The analysis used Item 16 natural gas utility data for San Francisco.

[30] Analysis of the kWh-per-therm electrification rate considered a range of data, including the electrification rates used in electrification analysis within the California Energy Commission 2021 Additional Achievable Fuel Substitution data, 2019 IEPR Decarbonization Docket (19-IEPR-06), comparisons of CEC model building scenarios within cost effectiveness studies with data specific to each Climate Zone developed through the Statewide Codes & Standards Utility Program, and building data provided by the San Francisco Department of Environment. Climate Zone 3 and/or San Francisco-specific data was prioritized due to San Francisco's mild climate and distinct HVAC and overall energy use profiles.

[31] Light duty auto battery electric vehicles (BEVs), light duty auto plug-in hybrid electric vehicles (PHEVs), and light duty trucks.

driven in a year[32] and the fuel economy (MWh/mile) per category[33] to identify registered vehicle annual energy use. A similar analysis was conducted for vehicles commuting into San Francisco.[34] Commercial vehicle electric energy use was forecasted using EIA Annual Energy Outlook data due to incomplete local data. California and national commercial truck registrations from 2019 were used to estimate California and San Francisco commercial truck sales, and adoption rates specific to achieving the City goals were applied across commercial vehicle classes.[35] The total annual energy requirements for all private and commercial electric vehicles were summed and shaped into hourly additional load using the managed EV hourly load shape provided in the 20-IEPR-03 report.

The hourly additional load data produced by the building electrification and the transportation electrification analyses were added to CleanPowerSF's baseline hourly demand to generate the Climate Action Plan Portfolio demand forecast.

III. Study Results

a. Conforming and Alternative Portfolios

CleanPowerSF developed two Conforming and two Alternative Portfolios under the 25 MMT scenario. Each portfolio contains a mix of resource types with varying development statuses (e.g., online, in development, planned). The 2035 portfolios for each case are summarized in the tables below.

Base Case

Solar is the most cost-effective renewable resource, pairing it with storage allows its generation to be delivered in the evening hours when the sun is not shining. The new build in this portfolio consists mostly of solar and both hybrid and standalone storage, but also includes 30 MW of geothermal not currently under contract and 240 MW of existing hydro and renewable resources which are included in all portfolios.

---

[32] Uses data on vehicle miles traveled (VMT) from the Metropolitan Transportation Commission Plan Bay Area 2040, Land Use Modeling Report linked on pp. 44, available at https://mtc.ca.gov/planning/long-range-planning/plan-bay-area-2040 [Accessed on 10/13/2022].
[33] Fuel efficiency is assumed to improve through the forecast period.
[34] The commuter traffic vehicle count was provided by the Mayor's Electric Vehicle Working Group's count of commuters, which was derived from a 2013 survey, available at https://sfenvironment.org/electricmobilitysf [Accessed on 10/12/2022].
[35] Adoption rates for electric trucks was sourced from International Council on Clean Transportation (ICCT) Working Paper 2020-28, which assessed the charging infrastructure required in San Francisco to support 100% electric vehicle use. https://theicct.org/wp-content/uploads/2021/06/SF-EV-charging-infra-oct2020.pdf [Accessed 10/14/2022].

Table 10: Base Case 2035 Portfolio

	RESOURCE	CONTRACT STATUS
Existing Resources Under Contract	San Pablo Raceway Solar (100 MW)	Online
	Blythe Solar (62.5 MW Solar, 47 MW Storage)	Online
	Maverick Solar+Storage (100 MW Solar, 50 MW Storage)	Online
	Voyager Wind IV Expansion (50.1 MW)	Online
	Oasis Wind (60.3 MW)	Online
	Geysers Geothermal (50 MW)	Online
	Sunset Reservoir Solar (5 MW)	Online
New Resources CleanPowerSF Has or Plans to Invest In	Aramis Solar (75 MW Solar, 75 MW Storage)	Development
	Paulsell Solar+Storage (20 MW Solar, 20 MW Storage)	Development
	University Mound – North Basin (3.5 MW Solar)	Development
	Sutro Reservoir (2.1 MW Solar)	Development
	Goal Line (10.8 MW Storage)	Development
	Tumbleweed (11.1 MW Storage)	Development
	Fish Lake (1.9 MW Geothermal)	Development
	Ormat Geothermal Portfolio (17.4 MW Geothermal)	Development
	Geothermal (30 MW)	Planned New
	Standalone Storage (325 MW)	Planned New
	Solar Hybrid (100 MW Solar, 50 MW Storage)	Planned New
Existing Resources CleanPowerSF Plans to Contract With	In-State Large Hydro (60 MW)	Planned Existing
	Blended Renewable and GHG-Free Existing Resources (180 MW)	Planned Existing

Time Coincident Case

The Time Coincident Case requires the development of 922 MW of new energy supply and storage capacity, to ensure CleanPowerSF demand is met in ≥90% of all hours with renewable and GHG-free resources. While this results in greater portfolio diversity, it also creates significant sales of excess generation to the market. This portfolio requires an additional 180 MW of new renewable and GHG-free resources as the Base Case to help meet the hourly constraint, again resulting in excess generation during certain hours that must be sold into the market.

Table 11: Time Coincident Case 2035 Portfolio

	RESOURCE	CONTRACT STATUS
Existing Resources Under Contract	San Pablo Raceway Solar (100 MW)	Online
	Blythe Solar (62.5 MW Solar, 47 MW Storage)	Online
	Maverick Solar+Storage (100 MW Solar, 50 MW Storage)	Online
	Voyager Wind IV Expansion (50.1 MW)	Online
	Oasis Wind (60.3 MW)	Online
	Geysers Geothermal (50 MW)	Online
	Sunset Reservoir Solar (5 MW)	Online
New Resources CleanPowerSF Has or Plans to Invest In	Aramis Solar (75 MW Solar, 75 MW Storage)	Development
	Paulsell Solar+Storage (20 MW Solar, 20 MW Storage)	Development
	University Mound – North Basin (3.5 MW Solar)	Development
	Sutro Reservoir (2.1 MW Solar)	Development
	Goal Line (10.8 MW Storage)	Development
	Tumbleweed (11.1 MW Storage)	Development
	Fish Lake (1.9 MW Geothermal)	Development
	Ormat Geothermal Portfolio (17.4 MW Geothermal)	Development
	Geothermal (60 MW)	Planned New

	RESOURCE	CONTRACT STATUS
	Standalone Storage (375 MW)	Planned New
	Solar Hybrid (100 MW Solar, 50 MW Storage)	Planned New
	Wind (100 MW)	Planned New
Existing Resources CleanPowerSF Plans to Contract With	In-State Large Hydro (60 MW)	Planned Existing
	Blended Renewable and GHG-Free Existing Resources (180 MW)	Planned Existing

Climate Action Plan Case (Alternative Portfolio)

The Climate Action Plan Case requires the most new resource development out of the four modeled portfolios, totaling 1,682 MW in new resource capacity by 2035. The greater capacity needs are a result of the additional customer demand projected by meeting San Francisco's 2040 GHG emission-free passenger trips and building decarbonization targets. On average, CleanPowerSF forecasts annual customer load to exceed its assigned IRP sales forecast[36] by 23% over the planning horizon in this Alternative Portfolio.[37] Additionally, the Climate Action Plan Case uses CleanPowerSF's behind-the-meter solar (BTM PV) generation assumptions, averaging 74% less installed capacity than its assigned BTM PV forecasts annually over the planning horizon.[38]

Table 12: Climate Action Plan Case 2035 Portfolio

	RESOURCE	CONTRACT STATUS
Existing Resources Under Contract	San Pablo Raceway Solar (100 MW)	Online
	Blythe Solar (62.5 MW Solar, 47 MW Storage)	Online

[36] See CPUC-assigned load forecasts and GHG benchmarks dated June 28, 2022: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/2022-final-ghg-emission-benchmarks-for-lses_public.xlsx [Accessed 9/21/2022].

[37] CleanPowerSF's load modifier assumptions for Alternative Portfolios are reported in the standard IEPR filing template in Appendix G.

[38] CleanPowerSF forecasted total BTM PV generation in its service territory by using historical Rule 21 interconnection data for San Francisco and applying a growth factor to forecast incremental annual capacity through the planning horizon, reported in Appendix G.

	RESOURCE	CONTRACT STATUS
	Maverick Solar+Storage (100 MW Solar, 50 MW Storage)	Online
	Voyager Wind IV Expansion (50.1 MW)	Online
	Oasis Wind (60.3 MW)	Online
	Geysers Geothermal (50 MW)	Online
	Sunset Reservoir Solar (5 MW)	Online
New Resources CleanPowerSF Has or Plans to Invest In	Aramis Solar (75 MW Solar, 75 MW Storage)	Development
	Paulsell Solar+Storage (20 MW Solar, 20 MW Storage)	Development
	University Mound – North Basin (3.5 MW Solar)	Development
	Sutro Reservoir (2.1 MW Solar)	Development
	Goal Line (10.8 MW Storage)	Development
	Tumbleweed (11.1 MW Storage)	Development
	Fish Lake (1.9 MW Geothermal)	Development
	Ormat Geothermal Portfolio (17.4 MW Geothermal)	Development
	Geothermal (30 MW)	Planned New
	Standalone Storage (225 MW)	Planned New
	Solar Hybrid (430 MW Solar, 230 MW Storage)	Planned New
	Wind (200 MW)	Planned New
	Offshore Wind (100 MW)	Planned New
Existing Resources CleanPowerSF Plans to Contract With	In-State Large Hydro (60 MW)	Planned Existing
	Blended Renewable and GHG-Free Existing Resources (180 MW)	Planned Existing

<u>Local Resource Procurement Case (Alternative Portfolio)</u>

The Local Resource Procurement Case requires 1,716 MW of new resource development by 2035, including 1,248 MW of local resource capacity. The Local Resource Procurement Case meets 50% of CleanPowerSF customer demand with local resource generation by 2030.[39] Similar to the Climate Action Plan Case, the Local Resource Procurement Case uses CleanPowerSF's behind-the-meter solar (BTM PV) capacity assumptions, with an estimated 135 MW of installed BTM PV capacity by 2035.[40]

Table 13: Local Resource Procurement Case 2035 Portfolio

	RESOURCE	CONTRACT STATUS
Existing Resources Under Contract	San Pablo Raceway Solar (100 MW)	Online
	Blythe Solar (62.5 MW Solar, 47 MW Storage)	Online
	Maverick Solar+Storage (100 MW Solar, 50 MW Storage)	Online
	Voyager Wind IV Expansion (50.1 MW)	Online
	Oasis Wind (60.3 MW)	Online
	Geysers Geothermal (50 MW)	Online
	Sunset Reservoir Solar (5 MW)	Online
New Resources CleanPowerSF Has or Plans to Invest In	Aramis Solar (75 MW Solar, 75 MW Storage)	Development
	Paulsell Solar+Storage (20 MW Solar, 20 MW Storage)	Development
	University Mound – North Basin (3.5 MW Solar)	Development
	Sutro Reservoir (2.1 MW Solar)	Planned New
	Goal Line (10.8 MW Storage)	Development
	Tumbleweed (11.1 MW Storage)	Development
	Fish Lake (1.9 MW Geothermal)	Development

[39] CleanPowerSF defines "local resources" as resources located in one of the nine Bay Area counties: Alameda, Contra Costa, Marin, Napa, San Francisco, San Mateo, Santa Clara, Solano, and Sonoma.

[40] Id.

	RESOURCE	CONTRACT STATUS
	Ormat Geothermal Portfolio (17.4 MW Geothermal)	Development
	Standalone Storage (75 MW)	Planned New
	Local Geothermal (25 MW)	Planned New
	Local Solar (1.3 MW)	Planned New
	Local Solar Hybrid (483.6 MW Solar, 460 MW Storage)	Planned New
	Local Wind (25 MW)	Planned New
Existing Resources CleanPowerSF Plans to Contract With	In-State Large Hydro (60 MW)	Planned Existing
	Blended Renewable and GHG-Free Existing Resources (180 MW)	Planned Existing
	Local Geothermal (25 MW)	Planned Existing

Compared to the 2021 Preferred System Plan, CleanPowerSF's portfolios exceed CleanPowerSF's proportional share of battery storage and geothermal, while only CleanPowerSF Alternative Portfolios exceeds CleanPowerSF's proportional share of new build solar and offshore wind. The Time Coincident and Climate Action Plan portfolios exceed CleanPowerSF's proportional share of wind resources. More new electricity supply and capacity build is needed to achieve San Francisco's aggressive clean energy goals, as illustrated by the resource needs of CleanPowerSF's Alternative Portfolios summarized above. CleanPowerSF will closely monitor load growth within its service area and will conduct additional long-term renewable energy and capacity procurement, as appropriate, to meet its customer's demand for these clean energy resources.

The greatest discrepancy between the 2021 Preferred System Plan and CleanPowerSF's Preferred Conforming Portfolio involves the combined total capacity of wind, battery storage and geothermal. The Preferred Conforming Portfolio requires more than twice the capacity of these resources than CleanPowerSF's 2035 proportional share in the 2021 PSP. The storage in these portfolios help shift the generation of lower cost intermittent renewable resources (like wind) while geothermal provides baseload generation that supplements intermittent renewables CleanPowerSF's energy resource portfolio. These portfolio results indicate that future CleanPowerSF procurement will prioritize the acquisition of resources that compliment solar and other intermittent generation.

Table 14: Comparison of CleanPowerSF Portfolios to 2021 Preferred System Plan

38 MMT 2021 PREFERRED SYSTEM PLAN	CLEANPOWERSF'S PROPORTIONAL SHARE (MW)	BASE CASE (MW)	TIME COINCIDENT (MW)	CLIMATE ACTION PLAN (MW)	LOCAL RESOURCE PROCUREMENT (MW)
Utility Scale Solar	377.7	200.6	200.6	530.6	585.5
Wind	49.4	0	100	200	25
Out-of-State Wind	21.0	0	0	0	0
Battery Storage	247.1	491.1	541.9	571.9	651.9
Offshore Wind	24.2	0	0	100	0
Geothermal	16.2	49.3	79.3	49.3	44.3

b. Preferred Conforming Portfolios

CleanPowerSF assigned the ranking in Table 15 below to each of the Conforming Portfolios, using the portfolio evaluation metrics discussed in the Modeling Approach section above. Based on this evaluation, CleanPowerSF brought the Time Coincident Case as its Preferred Conforming Portfolio to the San Francisco Public Utilities Commission for approval under both the 25 MMT and 30 MMT benchmarks. On October 24, 2022, the SFPUC approved the Time Coincident Case as the Preferred Conforming Portfolio for the 25 MMT and 30 MMT benchmarks.

Table 15: CleanPowerSF Portfolio Evaluation

	BASE CASE	TIME COINCIDENT CASE
Lead with Affordable Service		
Cost	1	2
Reliability	2	1
Diversity	2	1
Provide Cleaner Energy Alternatives		
Emissions	2	1
Renewable	Equivalent	
Invest in Local Projects and Jobs		
Local Investment	Equivalent	
Provide for Long-Term Rate and Financial Stability		
% Long-Term Energy	1	2
Market Exposure	2	1

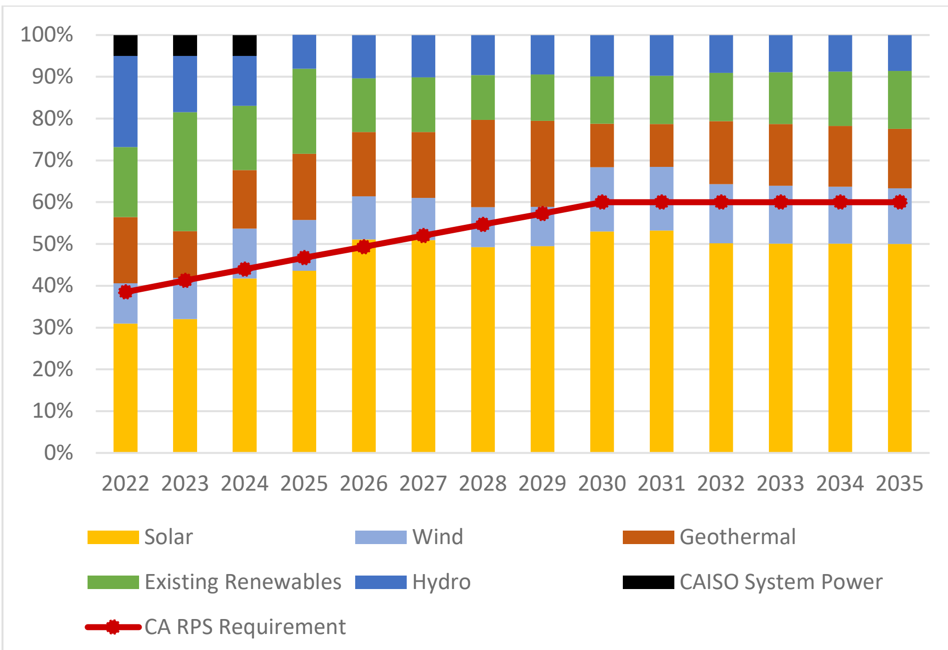
CleanPowerSF's Time Coincident Case portfolio should be used by the CPUC when aggregating all Load Serving Entity portfolio submissions in development of the 2023 Preferred System Plan. CleanPowerSF prefers this portfolio because it best aligns with local climate and power content goals established by San Francisco. The Time Coincident Case best accomplishes these goals and will more likely reflect CleanPowerSF's actual procurement strategy than the Base Case.

The Time Coincident Case is the best Conforming Portfolio for meeting and maintaining CleanPowerSF's program goal of a 100% renewable and/or GHG-free electricity supply on an annual basis by 2025. Ultimately, this portfolio was adopted as CleanPowerSF's Preferred Portfolio because it meets CleanPowerSF's program goals and best aligns with stakeholder preferences. While CleanPowerSF's stakeholder preferences were based on achieving the highest percentage of time coincidence, both the Base Case and Time Coincident Cases were found to perform equally in meeting local climate and power content goals. This suggests that CleanPowerSF can seek to implement a portfolio catered to a time coincidence goal without sacrificing local climate and power content goals.

CleanPowerSF's Preferred Conforming Portfolio will require the addition of 260 MW of new renewable resources and 350 MW of battery storage not currently under contract, by 2035. CleanPowerSF also has existing contracts for 100.6 MW of solar, 19.3 MW of geothermal, and 191.9 MW of battery storage that are expected to come online by that date.

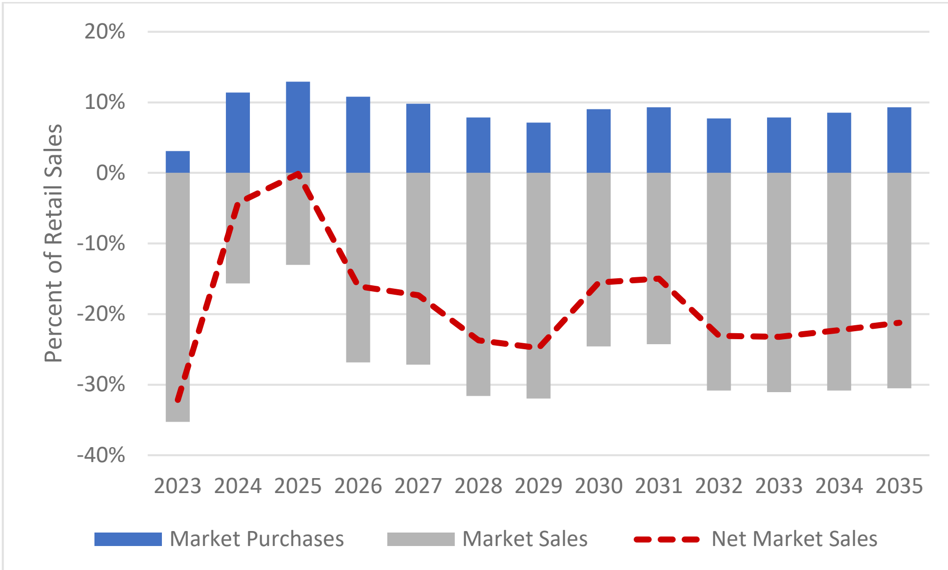
The Time Coincident Case meets CleanPowerSF's power content goals and exceeds California RPS targets for its managed retail sales. By 2035, the Time Coincident Case's energy supply relies heavily on new resource generation; existing renewables generate less than 14% and in- and out-of-state hydro generate less than 9% of total energy supply. The Time Coincident Case limited the quantity of available hydro it could procure to its proportional share of the California and Pacific Northwest future hydro generation from 2023-2035, consistent with the 2021 PSP.

Figure 4: CleanPowerSF Preferred Portfolio (Time Coincident Case) Power Content Summary



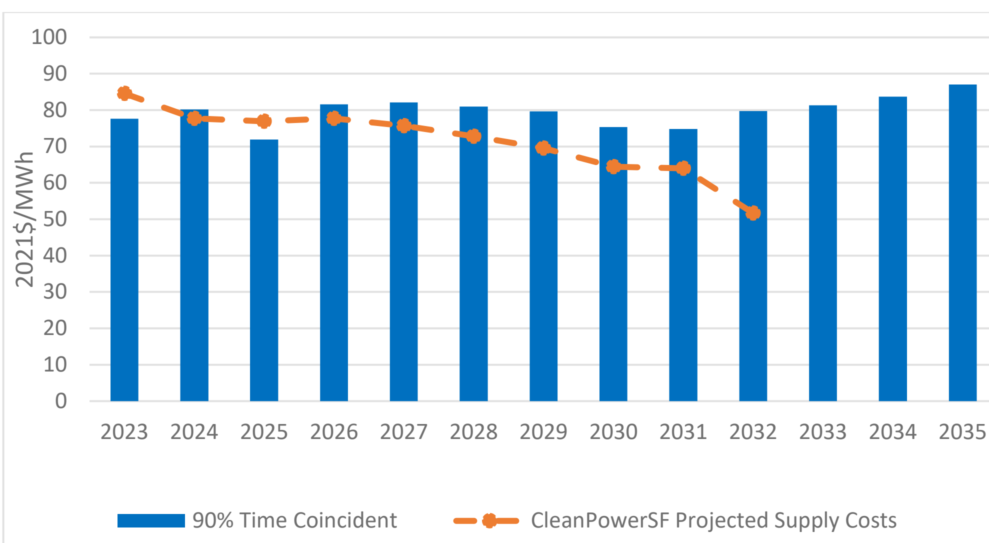
The Time Coincident Case relies on system sales, with net market sales peaking in 2023 at 32% and accounting for 21% percent of CleanPowerSF's total demand in 2035. This indicates that the portfolio is fairly well balanced in terms of the amount of energy it is expected to supply the CAISO system versus the amount of energy it is expected to draw from the CAISO system.

Figure 5: Time Coincident Case Net Market Sales



The Time Coincident Case was estimated to be slightly more expensive than the Base Case portfolio, due to the extra capacity needed to meet the 90% time coincidence constraint. The Time Coincident Case normalized portfolio costs are slightly higher than CleanPowerSF's supply cost projection used in its most recent 10-year Financial Plans, however, market prices have increased since those projections were developed, and new build project costs are also up due to inflationary and supply chain issues. In 2035, the total weighted average portfolio cost is expected to be $87.02/MWh (2021$). The steady projected portfolio costs indicate that CleanPowerSF ratepayers can expect their rates to follow a similar trajectory while receiving an increasingly clean and reliable electricity supply.

Figure 6: Time Coincident Case Energy Portfolio Costs (2021$)



As stated above, CleanPowerSF prefers that its Time Coincident Case portfolio be used for CPUC systemwide aggregation purposes. CleanPowerSF has evaluated how this portfolio may perform from a reliability perspective if other LSEs procure in a manner that is consistent with the 2021 Preferred System Plan and projects that it will contribute CleanPowerSF's share of reliability needs.

A resource's Effective Load Carrying Capacity (ELCC) represents its contribution to system reliability as a percentage of its nameplate capacity. This value is dependent of the mix of resources on the system and penetration of any one resource. This means that as the amount of a renewable resource on the grid increases, its incremental contribution to system reliability decreases. The table below demonstrates how annual ELCC assumptions differ between the 30 MMT and 25 MMT Conforming Portfolios.

Table 16: Annual ELCC Summary

		2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
30 MMT	Solar	10%	10%	11%	10%	9%	8%	6%	6%	6%	6%	6%	6%
	Wind (N. CA)	30%	30%	31%	24%	17%	17%	16%	15%	13%	12%	10%	9%
	4-Hour Storage	89%	90%	92%	85%	77%	76%	75%	68%	61%	54%	47%	40%
	8-Hour Storage	89%	91%	93%	90%	87%	86%	85%	82%	79%	76%	73%	70%
25 MMT	Solar	12%	12%	12%	10%	8%	8%	7%	7%	7%	7%	7%	6%
	Wind (N. CA)	24%	27%	31%	21%	12%	15%	19%	17%	15%	13%	11%	9%
	4-Hour Storage	85%	86%	87%	85%	82%	85%	89%	79%	69%	60%	50%	40%
	8-Hour Storage	89%	89%	88%	87%	86%	87%	89%	85%	81%	77%	73%	70%

Solar and wind resources contribute less to system reliability over time based on assumptions provided by the CPUC due to the increased penetration of these resources needed to achieve lower emissions. CleanPowerSF evaluated how the system RA contributions of long-term resources in the Time Coincident Case differed under each set of assumptions. The results are in Figures 7 and 8, which shows that the long-term renewable portion of the portfolio contributes the most to system reliability needs under each of the two emissions targets. In the mid-term, the portfolio has a slightly higher RA value because the ELCC for storage is higher under the 25 MMT scenario (ELCCs are higher for 4-hour storage beginning in 2028 and for 8-hour storage beginning in 2029). Steeper declines in the value of solar ELCC in later years result in less RA value in later years. By pairing much of the solar in CleanPowerSF's Time Coincident Case with storage, CleanPowerSF prevents significant drops in the RA value of the portfolio regardless of whether the rest of the system is more reflective of the 30 MMT or 25 MMT planning target.

Figure 7: 25 MMT Time Coincident Case Long-Term System Reliability Contributions

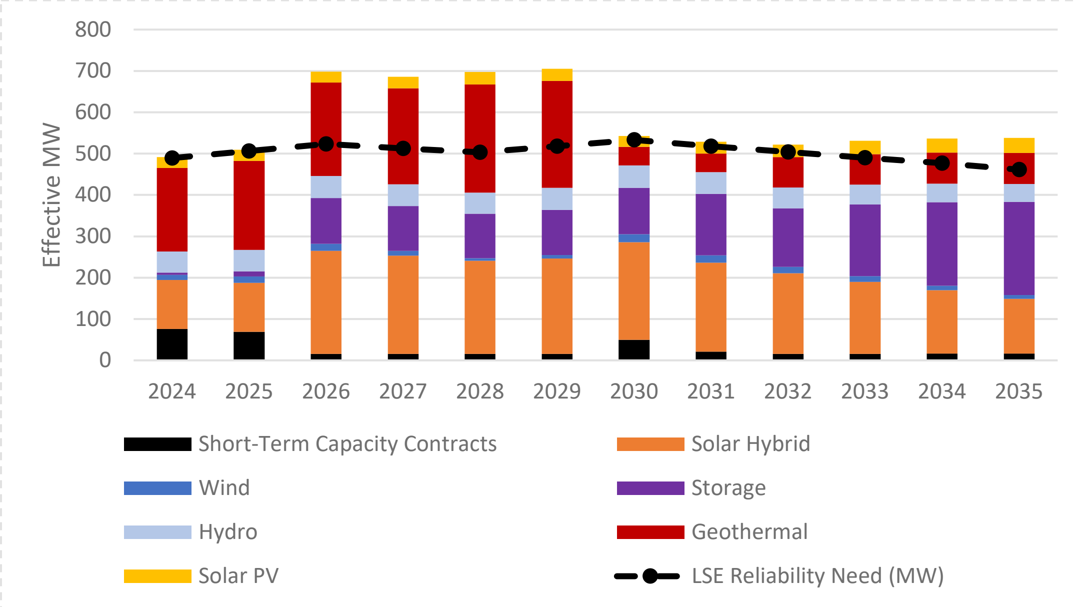
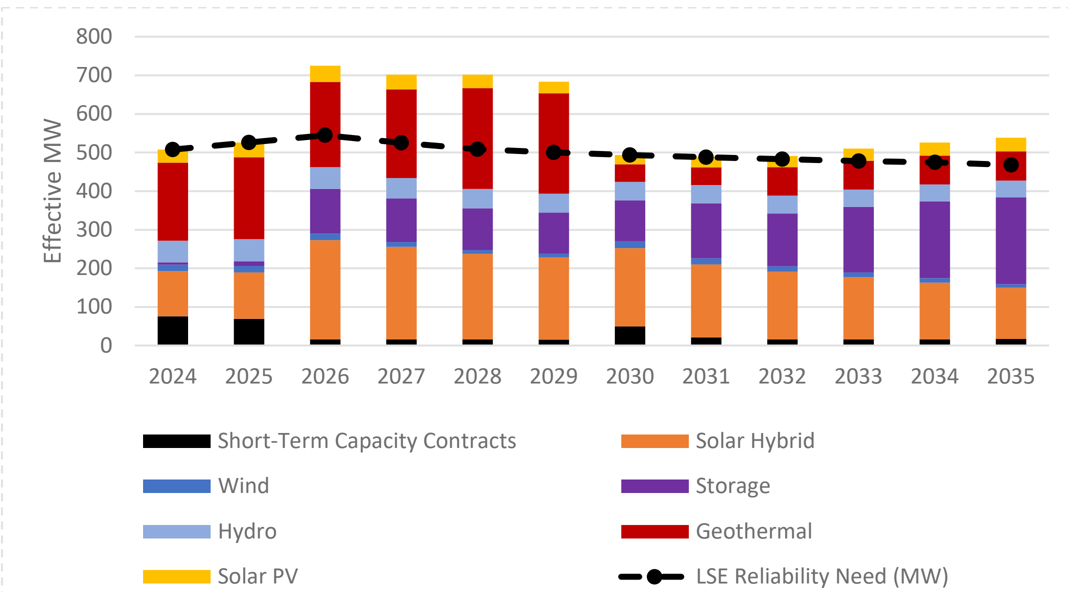


Figure 8: 30 MMT Time Coincident Case Long-Term System Reliability Contributions



The increased amount of storage in the Time Coincident Case also helps increase the time coincidence of the portfolio by shaping renewable generation to better meet demand. This increases the reliability of CleanPowerSF's portfolio because it maximizes the amount of customer demand that can be met with renewable energy on an hourly basis.

CleanPowerSF's Preferred Conforming Portfolio is consistent with the requirements for a LSE's IRP listed in Public Utilities Code Section 454.52(a)(1) as it:

- Emits less carbon dioxide than CleanPowerSF's emissions benchmark under the 30 MMT and 25 MMT statewide targets.
- Exceeds the 60% RPS requirement, containing up to 100% RPS-eligible renewables and 100% GHG-free energy on an annual basis beginning in 2025.
- Maintains costs associated with the supply portfolio at a level that is reasonable, given current market conditions and price forecasts, allowing CleanPowerSF to continue providing customers with affordable and stable rates.
- Meets 65% of its projected System Resource Adequacy obligation with long-term contracted resources containing bundled energy and capacity attributes by 2035.
- Prioritizes resources within the Bay Area region, contributing local reliability and transmission benefits.
- Minimizes CleanPowerSF's reliance on system power and emitting resources like natural gas plants which are disproportionately located in California's Disadvantaged Communities.

c. GHG Emissions Results

CleanPowerSF was assigned a GHG emissions benchmark under each of the statewide targets in a CPUC Administrative Law Judge Ruling.[41] These GHG emissions benchmarks are included in the table below:

Table 17: CleanPowerSF GHG Emissions Benchmarks

2035 GHG PLANNING TARGET	30 MMT	25 MMT
CleanPowerSF 2035 GHG Benchmark (MMT)	0.340	0.272

In addition to the emissions associated with its power supply, all Load Serving Entities submitting an IRP were assigned an allocation of non-dispatchable wholesale, (i.e., in front of the meter) Combined Heat and Power (CHP) facility GHG emissions based on each LSE's load ratio share (i.e., their share of the system annual energy usage). These CHP resources are assumed to provide energy through 2035 because they are part of an industrial or commercial process and export excess electricity they generate to the grid. These processes help support system reliability, which benefits all LSEs. Additionally, Energy Division staff will add in behind-the-meter CHP emissions when calculating electric sector emissions of the aggregated LSE portfolios during the development of the next Preferred System Plan. These

[41] R.20-05-003, ALJ Ruling on Forecasts and GHG Benchmarks, pp. 10-11.

emissions had previously been attributed to the Industrial sector and are now attributed to the electricity sector to align with California Air Resource Board (CARB) statewide emissions accounting. These emissions are not associated with specified purchases by CleanPowerSF.[42] Due to the assignment of CHP emissions, CleanPowerSF's submitted portfolios need to emit slightly less than their assigned benchmark to ensure that the electricity sector as a whole meets its GHG emissions targets.

The 25 MMT Time Coincident Case portfolio CO_2 emissions are 0.013 MMT in 2035, which are 95% lower than CleanPowerSF's assigned 25 MMT benchmark of 0.272 MMT. This portfolio does not contain any specified purchases of emitting resources and most of the emissions, 0.04 MMT in 2035, are from CleanPowerSF's assigned proportional share of emissions from CHP operating on the system. CleanPowerSF receices a CO_2 emissions credit in the CSP calculator in 2035, (0.03) MMT, due to oversupply at the system power emissions rate when hourly supply exceeds hourly load and system power is on the margin. CleanPowerSF's 25 MMT and 30 MMT CSP Calculator results are shown in Tables 18 and 19, respectively.

Table 18: 25 MMT Time Coincident Case Clean System Power Calculator Results

Emissions Total	***Unit***	**2024**	**2026**	**2030**	**2035**
CO_2	*MMt/yr*	0.310	0.088	0.163	0.013
PM2.5	*tonnes/yr*	17.146	2.408	5.699	0.074
SO_2	*tonnes/yr*	4.276	0.276	0.582	0.040
NOx	*tonnes/yr*	49.417	16.248	19.372	4.253

Table 19: 30 MMT Time Coincident Case Clean System Power Calculator Results

Emissions Total	***Unit***	**2024**	**2026**	**2030**	**2035**
CO_2	*MMt/yr*	0.313	0.085	0.161	0.022
PM2.5	*tonnes/yr*	17.373	2.252	6.259	0.391
SO_2	*tonnes/yr*	4.299	0.265	0.637	0.073
NOx	*tonnes/yr*	49.627	16.460	20.684	5.998

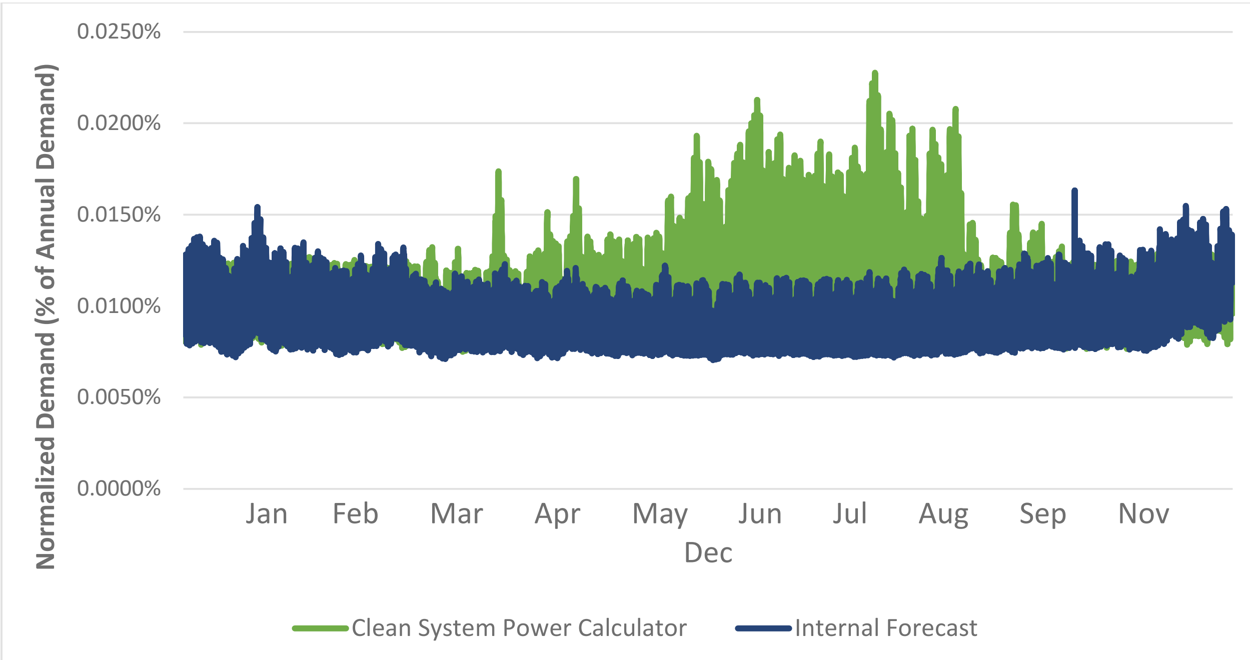
CleanPowerSF used a custom demand shape in its IRP analysis and in the CSP Calculator.[43] A normalized shape using CleanPowerSF's internally developed load forecast was compared against the generic shape provided for all LSEs in the CPUC's Clean System Power Calculator. Hourly differences of up to 49 percent between the two resulted in CleanPowerSF opting to use a custom shape in its 2022 IRP analysis. As Figure 9 demonstrates, CleanPowerSF is a winter peaking program and has lower demand than the CAISO system average during the summer months, due in part to San Francisco's

[42] See id.

[43] CleanPowerSF's custom demand shape was applied to both baseline demand profiles for non-commercial and industrial demand and commercial and industrial demand in the CSP Calculator.

unique weather which has cooler than average summer months and lower load during this time of the year.

Figure 9: CleanPowerSF Load Shape



CleanPowerSF's custom load shape was developed using 2021 actual energy consumption and makes several adjustments based on expected changes to energy demand in the years ahead. CleanPowerSF's 2021 actual energy consumption was adjusted for modest reductions in future load caused by Direct Access departing customers in the winter of 2021/22 and, based on an internal analysis of COVID recovery, a 0.5% annual load growth factor was applied. Demand for each hour of the year was normalized by dividing it by 8,760, the total number of hours in a calendar year. Using these inputs, the Aurora model applied the hourly shape to the monthly energy and peak forecast to automatically generate an hourly load forecast for each year of the study period.

CleanPowerSF utilized a custom load shape for BTM PV in the development of its Conforming Portfolios. CleanPowerSF's assigned BTM PV forecast is based on CleanPowerSF's pro-rata share of load consistent with IEPR forecasts and is significantly higher than CleanPowerSF's BTM PV load forecasts. To reconcile the over-allocation of BTM PV generation, CleanPowerSF relied on the load shape of a baseload resource to smooth assigned BTM PV load evenly across all hours of the day to best mimic CleanPowerSF's expected mid-day BTM PV generation. This approach is intended to reflect the relevant climate conditions in San Francisco while meeting the requirement to use BTM PV forecast assignments in the development of the two Conforming Portfolios.

d. Local Air Pollutant Minimization and Disadvantaged Communities

i. Local Air Pollutants

The statutory requirement for CleanPowerSF's IRP to minimize localized air pollutants and other greenhouse gas emissions "with an early priority on disadvantaged communities is effectively achieved by CleanPowerSF's Time Coincident Case portfolio.[44]

Tables 20 and 21 below show the PM2.5, SO_2, and NOx criteria pollutant emissions for the Time Coincident Case under the 25 MMT and 30 MMT scenarios. The CPUC's CSP Calculator assigns system power emissions to LSEs on an hourly basis. Additionally, a portion of these system power emissions are assigned to CleanPowerSF regardless of its available energy supply, which means system power emissions are assigned during certain hours even if CleanPowerSF's supply portfolio is meeting its demand with renewable resources in those hours. This is because there are certain hours of the day when emitting facilities must run even if there is over generation of non-emitting resources on the system. To ensure that all system emissions are accounted for across LSE portfolios during such hours, emissions from system power are allocated to LSEs on a pro rata basis. These are the emissions that cannot be displaced by the addition of renewable resources on the system.

The second source of CleanPowerSF's portfolio criteria pollutant emissions results are emissions from CHP resources. Even though CleanPowerSF does not contract with any CHP facilities, emissions from non-dispatchable wholesale (i.e., in-front-of-the-meter) CHP generators are automatically allocated in the CPUC's Clean System Power Calculator to LSEs proportional to their load share. More detail on this process can be found in the CPUC's Clean System Power Calculator Documentation.[45] CleanPowerSF plans to strategically procure resources to reduce the system power content of CleanPowerSF's portfolio. These procurement strategies are discussed further in the Action Plan section of this plan.

[44] See Public Utilities Code Section 454.52(a)(1)(H)).

[45] The Clean System Power Calculator Documentation is titled "Greenhouse Gas and Criteria Pollutant Accounting Methodology for use in Load-Serving Entity Portfolio Development in 2022 Integrated Resource Plans," July 2022. https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/clean-system-power-calculator-documentation.pdf [Accessed 10/30/2022]

Table 20: 25MMT Time Coincident Case Criteria Pollutant Results

PM2.5	***Unit***	**2024**	**2026**	**2030**	**2035**
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	4.04	3.98	3.89	2.40
Biogas	*tonnes/yr*	0.80	-	-	-
Biomass	*tonnes/yr*	7.26	-	-	-
System Power	*tonnes/yr*	5.05	(1.57)	1.81	(2.33)
Total	***tonnes/yr***	**17.15**	**2.41**	**5.70**	**0.07**
Average emissions intensity	*kg/MWh*	0.01	0.00	0.00	0.00

SO_2	***Unit***	**2024**	**2026**	**2030**	**2035**
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	0	0	0	0
Biogas	*tonnes/yr*	1	-	-	-
Biomass	*tonnes/yr*	3	-	-	-
System Power	*tonnes/yr*	0	(0)	0	(0)
Total	***tonnes/yr***	**4**	**0**	**1**	**0**
Average emissions intensity	*kg/MWh*	0.0014	0.0001	0.0002	0.0000

NOx	***Unit***	**2024**	**2026**	**2030**	**2035**
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	19	18	18	9
Biogas	*tonnes/yr*	3	-	-	-
Biomass	*tonnes/yr*	22	-	-	-
System Power	*tonnes/yr*	6	(2)	2	(5)
Total	***tonnes/yr***	**49**	**16**	**19**	**4**
Average emissions intensity	*kg/MWh*	0.0166	0.0054	0.0062	0.0013

Table 21: 30MMT Time Coincident Case Criteria Pollutant Results

PM2.5	Unit	2024	2026	2030	2035
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	4.04	4.01	3.97	2.45
Biogas	*tonnes/yr*	0.80	-	-	-
Biomass	*tonnes/yr*	7.26	-	-	-
System Power	*tonnes/yr*	5.27	(1.76)	2.29	(2.06)
Total	***tonnes/yr***	**17.37**	**2.25**	**6.26**	**0.39**
Average emissions intensity	*kg/MWh*	0.01	0.00	0.00	0.00

SO_2	Unit	2024	2026	2030	2035
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	0.43	0.43	0.42	0.26
Biogas	*tonnes/yr*	0.58	-	-	-
Biomass	*tonnes/yr*	2.79	-	-	-
System Power	*tonnes/yr*	0.49	(0.16)	0.21	(0.19)
Total	***tonnes/yr***	**4.30**	**0.27**	**0.64**	**0.07**
Average emissions intensity	*kg/MWh*	0.00	0.00	0.00	0.00

NOx	Unit	2024	2026	2030	2035
Coal	*tonnes/yr*	-	-	-	-
CHP	*tonnes/yr*	19	19	18	10
Biogas	*tonnes/yr*	3	-	-	-
Biomass	*tonnes/yr*	22	-	-	-
System Power	*tonnes/yr*	6	(2)	2	(4)
Total	***tonnes/yr***	**50**	**16**	**21**	**6**
Average emissions intensity	*kg/MWh*	0.0167	0.0055	0.0066	0.0018

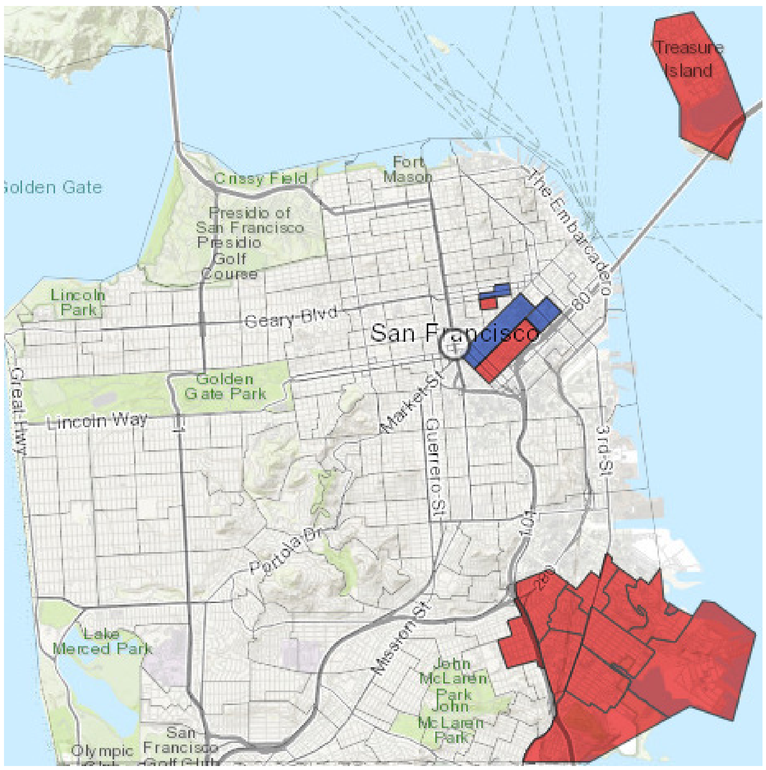
ii. Focus on Disadvantaged Communities

CleanPowerSF aims to address the disproportionate environmental burdens historically faced by typically low-income communities predominated by people of color by maximizing the renewable content of its portfolio and minimizing procurement from polluting facilities located in these communities.

The California Office of Environmental Health and Hazard Assessment developed the CalEnviroScreen tool to identify Disadvantaged Communities in the State. It assigns a score to each census tract in the state based on a range of environmental, health, and socioeconomic factors to help identify census tracts in California that are most impacted by pollution and where individuals are most vulnerable to its effects. A higher score indicates that a community is more impacted. A Disadvantaged Community, for the purposes of this IRP, refers to California census tracts in the top 25th percentile of CalEnviroScreen 4.0 scores.

CleanPowerSF identified 14 census tracts within San Francisco that are Disadvantaged Communities. CleanPowerSF serves customers within 13 of these census tracts.[46] Collectively, these census tracts have a population of approximately 55,114. Nine of these tracts are in the Hunters Point region of San Francisco, two are around the Portola/Sunnydale/Visitation neighborhoods, one rests in the Moscone Center/South of Market (SoMA) neighborhoods, and the remaining one is in the Civic Center area. The 14th census tract is on Treasure Island, which is entirely served by Hetch Hetchy Power, San Francisco's public power utility. Figure 10 below identifies the locations of San Francisco's Disadvantaged Communities. Census tracts identified in the top 25th percentile of CalEnviroScreen 4.0 scores are in red and census tracks identified in CalEnviroScreen 3.0 are in blue. Table 22 and 23 provide additional information on CleanPowerSF customers in each of these census tracts.

Figure 10: San Francisco's Disadvantaged Communities



[46] A twelfth census tract, located on Treasure Island is entirely served by Hetch Hetchy Power, San Francisco's municipal electric utility.

Table 22: CleanPowerSF Disadvantaged Communities (CalEnviroScreen 3.0)

CLEANPOWERSF RESIDENTIAL CUSTOMER TOTAL CENSUS TRACT	CLEANPOWERSF RESIDENTIAL CUSTOMER TOTAL	CLEANPOWERSF COMMERCIAL CUSTOMER TOTAL	CLEANPOWERSF CUSTOMER TOTAL
6075012301	706	186	892
6075012502	1,027	134	1,161
6075017601	7,172	912	8,084
6075017801	1,611	178	1,789
6075017902	1	0	1
6075023102	1,656	55	1,711
6075023103	1,181	129	1,310
6075023200	1,266	407	1,673
6075023300	1,330	140	1,470
6075023400	730	290	1,020
6075061200	1,214	150	1,364
6075980600	180	20	200
Grand Total	**18,074**	**2,601**	**20,675**

Table 23: CleanPowerSF Disadvantaged Communities (CalEnviroScreen 4.0)

CENSUS TRACT	CLEANPOWERSF RESIDENTIAL CUSTOMER TOTAL	CLEANPOWERSF COMMERCIAL CUSTOMER TOTAL	CLEANPOWERSF CUSTOMER TOTAL
6075012502	1,027	134	1,161
6075017802	4,175	702	4,877
6075017902	1	0	1
6075023001	1,239	119	1,358
6075023003	1,146	47	1,193
6075023102	1,656	55	1,711
6075023103	1,181	129	1,310
6075023200	1,266	407	1,673
6075023300	1,330	140	1,470
6075023400	730	290	1,020
6075025702	1,182	207	1,389
6075061000	1,576	69	1,645
6075061200	1,214	150	1,364
6075980600	180	20	200
Grand Total	**17,903**	**2,469**	**20,372**

CleanPowerSF serves 20,372 customers in San Francisco's Disadvantaged Communities which represent 5.26% percent of total CleanPowerSF customers.

While CleanPowerSF does not currently make specified purchases of energy from emitting facilities in Disadvantaged Communities, it is committed to minimizing its system power emissions and providing the following benefits to Disadvantaged Communities in and outside of its service area:

- <u>Reduction in Use of Polluting Power Plants in Disadvantaged Communities</u>: Through procurement of California and Bay Area renewable energy at levels above the state RPS requirements, CleanPowerSF plays a part in moving away from reliance on natural gas power plants and their emissions, which disproportionately affect Disadvantaged Communities. The City and County of San Francisco, which operates the CleanPowerSF program, has successfully collaborated with state energy planning agencies in the past to close down large in-city pollution-emitting power plants (in the Hunters Point and Potrero areas of San Francisco).

- <u>Prioritization on Program Affordability and Stability:</u> As previously discussed, CleanPowerSF program goals include affordability and long-term rate stability. CleanPowerSF's net revenues go back to ratepayers, either in the form of lower rates or customer-sided programming and incentives. CleanPowerSF's financial reserves provide rate stabilization protection of its most economically vulnerable ratepayers.

- Programs Accessible to All: As CleanPowerSF continues to develop new customer-sided programming, programs for Disadvantaged Communities and hard-to-reach populations – including financing and offerings for multi-family residential – are a top priority.

CleanPowerSF currently offers and is in the process of planning programs with the aim of providing benefits to low-income customers and customers located in Disadvantaged Communities:

- GoSolarSF, the SFPUC's solar incentive program provided more than $1 million in financial incentives to support low-income access to on-site renewable generation at more than 120 customer sites since CleanPowerSF began service in 2016. While the GoSolarSF Program retired most all its solar incentive rebate categories, its one remaining solar rebate category supports exclusively Disadvantaged Communities – Single-Family Solar Homes (DAC-SASH) eligible customers receiving solar system through Grid Alternatives.[47]

- In 2022, CleanPowerSF began offering a Solar Inverter Replacement Program. The Solar Inverter Replacement Program provides up to $3,000 in rebates to CleanPowerSF CARE or FERA customers who previously installed solar through the GoSolarSF program.[48] The program helps assure these systems can continue to operate by offering the bill reduction and environmental benefits intended for these low-income customers who likely need support for inverter repairs.

- CleanPowerSF's Budget Billing program helps low-income customers avoid big swings in their monthly payments by averaging their energy costs and providing a predictable and stable monthly bill.[49]

- CleanPowerSF launched its Disadvantaged Communities Green Tariff (DAC-GT) and Community Solar Green Tariff (DAC-CSGT) programs, enrolling eligible customers in the former program beginning June 2022.[50] These programs are administered by the CPUC and reduce barriers to renewable energy adoption by residents in Disadvantaged Communities.

---

[47] SFPUC. GoSolarSF. Available at: https://sfpuc.org/accounts-services/sign-up-for-savings/gosolarsf [Accessed 10/12/2022]

[48] CleanPowerSF. Solar Inverter Replacement Program. Available at: https://www.cleanpowersf.org/solarinverter [Accessed 10/12/2022]

[49] CleanPowerSF. Budget Billing Program. Available at: https://www.cleanpowersf.org/budgetbilling#:~:text=Budget%20Billing%20is%20a%20free,a%20monthly%20budget%20bill%20amount [Accessed 10/12/2022]

[50] More information on CleanPowerSF's Disadvantaged Communities Green Tariff program is available at: https://www.cleanpowersf.org/supergreensaver [Accessed 10/13/2022]

Both these programs allow customers in DACs to subscribe to up to 100% RPS-renewable energy at a 20% discount through their electricity provider.

- CleanPowerSF is developing energy efficiency programming to support food services, including restaurants, grocery stores, refrigerated warehouses and community food services. The program would support energy efficiency measures for refrigeration, food preparation equipment, ventilation controls and other technologies.[51] New equipment and energy savings will improve the financial viability and long-term operational efficiency of participating organizations, which we hope will include child & senior care centers, free dining rooms, grocery/food pantries, and other community support centers.

- CleanPowerSF currently partners with other CCAs and the Bay Area Regional Energy Network (BayREN) to deliver an incentive program to promote contractor education and sales of heat pump water heaters (HPWHs). CleanPowerSF seeks to expand the use of HPWHs and similar technologies for low-income households and multifamily buildings through targeted outreach and education.[52]

- CleanPowerSF expects to launch EV Charge SF, an EV charging incentive program aimed at new and recent construction, in 2023. Affordable housing will be prioritized within the program through an additional 20% to all incentives and will be offered technical assistance to support the design of charging infrastructure and ensure compliance with state and local ordinances for less sophisticated customers.

CleanPowerSF is committed to continuing to address issues of equity when it comes to accessing renewable energy and distributed energy resources (DERs). CleanPowerSF established a working group tasked with developing an equity framework to guide the development of additional customer programs, policies, and business practices that are inclusive and directly address the community's needs. This equity framework is now being used by the Power Enterprise to inform customer program development initiatives undertaken at the SFPUC.

e. Cost and Rate Analysis

CleanPowerSF's Rate Setting Process

CleanPowerSF rates are subject to several levels of public oversight, and any changes must be approved by the SFPUC at a noticed public meeting. CleanPowerSF's rates are created with the input, guidance and review of the Rate Fairness Board, an advisory group of ratepayers and City financial

---

[51] See CPUC Resolution E-5180 certifying CleanPowerSF's Energy Efficiency Program Administration available at: https://docs.cpuc.ca.gov/PublishedDocs/Published/G000/M441/K154/441154671.PDF [Accessed 10/13/2022]

[52] CleanPowerSF Heat Pump Water Heater Program. https://www.cleanpowersf.org/heat-pump-water-heater-program. [Accessed 10/12/2022]

officers created under the voter-approved Proposition E (2002), to ensure rate stability, fairness and affordability. [53] Before each rate change, the Rate Fairness Board holds a public meeting, after which a report or recommendation is provided to the SFPUC.

The SFPUC sets CleanPowerSF retail rates pursuant to the San Francisco Charter Section 8B.125.[54] All budgets, rates, fees, and charges presented by staff to the SFPUC must conform to the SFPUC Ratepayer Assurance Policy, which is guided by the key principles of: revenue sufficiency, customer equity, environmental sustainability, affordability, predictability, and simplicity. As required by San Francisco Charter section 16.112, a Notice of Public Hearing on the establishment of new rates is published in various forums. [55]

If approved by the five member San Francisco Public Utilities Commission, pursuant to Charter Section 8B.125, the rates are subject to rejection by the San Francisco Board of Supervisors (BOS) within thirty (30) days of notification to the BOS.

IRP Cost and Rate Analysis

CleanPowerSF's program goals include providing San Francisco residents and businesses with affordable rates and long-term rate stability. For its IRP analysis, CleanPowerSF modeled the most cost-effective portfolio for each scenario analyzed to ensure the portfolios developed align with program priorities.

CleanPowerSF's Preferred Portfolio is within a reasonable range of CleanPowerSF's projection of future supply costs in its most recent 10-Year Financial Plan[56] (adopted in February 2022), as shown in Figure 11. The total cost of the Time Coincident portfolio is projected to be around $81.03/MWh (2021$) in net present value. The Time Coincident portfolio cost represents a less than 1.1% average annual increase in portfolio costs over the 13 years from 2023 to 2035. This is lower than trends for the past 10 years in PG&E's service territory, which saw system average generation rates increase at an average annual rate of approximately 5.1%.[57]

[53] More information on the Rate Fairness Board is available at: https://sfpuc.org/about-us/boards-commissions-committees/rate-fairness-board [Accessed 10/13/2022]

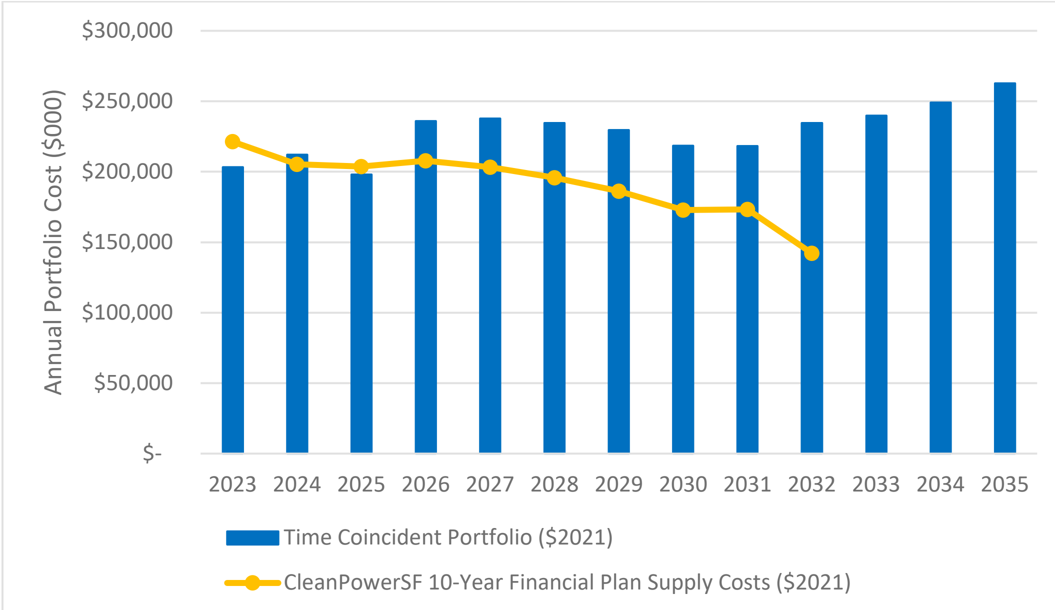
[54] See San Francisco Public Utilities Commission Comprehensive Annual Financial Report, Financial Authority and Policies, available at: https://sfwater.org/modules/showdocument.aspx?documentid=9975

[55] Charter Section 16.112 requires notices to be posted in the official newspaper, SFPUC website, and at the San Francisco Public Library prior to a public hearing.

[56] San Francisco Public Utilities Commission Resolution 22-032, adopted on February 8, 2022.

[57] PG&E's 2012 and 2022 Annual Electric True-Up Filings outlining revisions to electric tariffs are available at: https://www.pge.com/rates/tariffs/tm2/pdf/ELEC_4096-E.pdf and https://www.pge.com/tariffs/assets/pdf/adviceletter/ELEC_6509-E-A.pdf [Accessed 10/12/2022]

Figure 11: Preferred Portfolio Costs Compared to CleanPowerSF 10-Year Financial Plan Supply Costs



f. System Reliability Analysis

In its IRP analysis, CleanPowerSF applied its marginal reliability need (MRN), as calculated in the Resource Data Template (RDT) using the annual CPUC-assigned managed peak share, as a floor for its modeled portfolios. CleanPowerSF's annual MRN ensures enough dispatchable resources under contract to meet customer demand during specified periods of high demand. As such, CleanPowerSF has determined that projected contributions towards its annual MRN are an appropriate metric for measuring a portfolio's contributions to systemwide reliability for this IRP cycle.

CleanPowerSF shares the concerns of state regulatory agencies regarding the continued reliability of the state's electric system as an increasing number of variable energy resources are added to the grid. CleanPowerSF prioritizes its responsibility to provide reliable and clean electricity to its customers, especially during peak hours. CleanPowerSF plans the development of its energy resource portfolio to meet its RA obligations, and through this IRP analysis CleanPowerSF aimed to develop portfolios that contribute its fair share to forecasted systemwide reliability needs.

In developing its IRP, CleanPowerSF utilized the best available information to analyze the reliability of its IRP portfolios. Specifically, CleanPowerSF required that each portfolio developed meet at least 65% of CleanPowerSF's annual MRN with new long-term contracts that provide energy and capacity. CleanPowerSF also limited annual market purchases to no more than 20% of total annual energy all modeled portfolios.

Figures 12 and 13 below summarize CleanPowerSF's annual contribution to system reliability under the 25 MMT and 30 MMT scenarios. As shown, the majority of CleanPowerSF's MRN will be met by a mix of new and existing contracts long-term contracts and short-term capacity contracts.

Figure 12: CleanPowerSF 25 MMT Time Coincident Case Contribution to System Reliability by Year

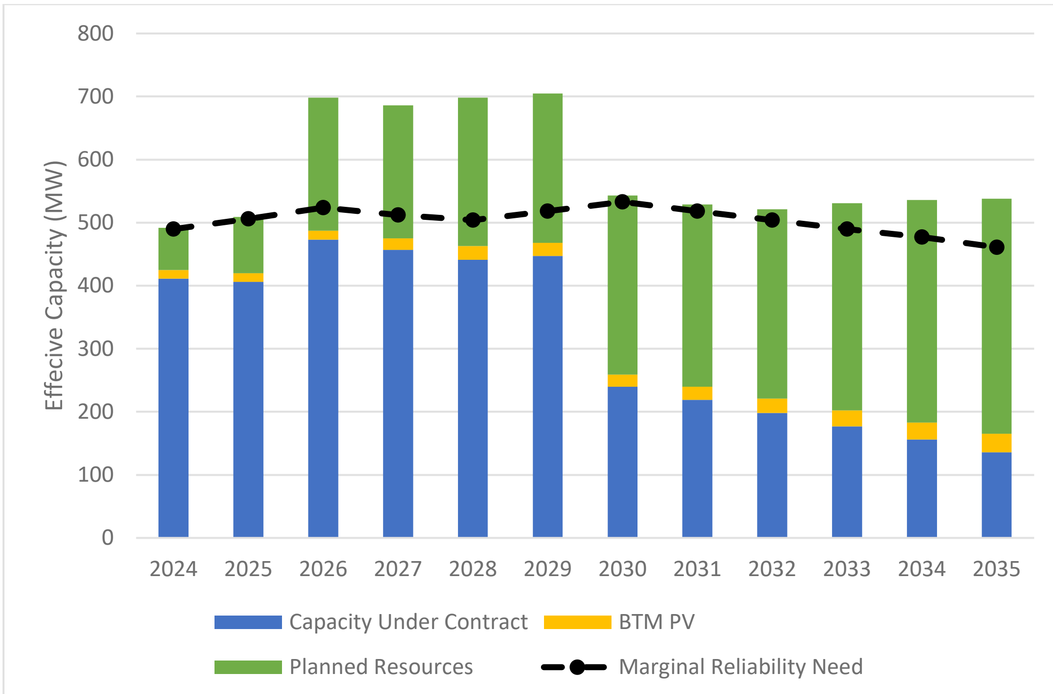
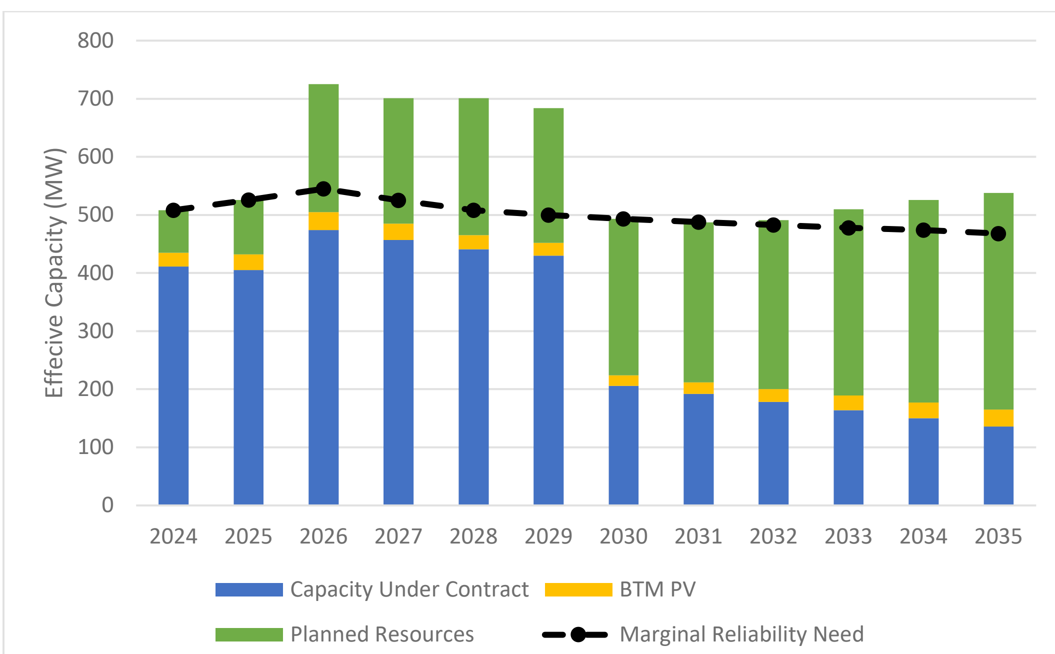


Figure 13: CleanPowerSF 30 MMT Time Coincident Case Contribution to System Reliability by Year



Over the planning horizon, CleanPowerSF believes its RA needs will be met by a mix of additional CleanPowerSF procurement of long-term resources, firm and short-term capacity contracts, and Cost Allocation Mechanism (CAM) resources, as shown in Tables 24 and 25 below and in the Resource Data Templates in Appendices A and B.

Table 24: 25 MMT Time Coincident Case Resource Data Template Reliability Need and Capacity Position (Effective MW)

	MARGINAL RELIABILITY NEED	CAPACITY UNDER CONTRACT	BTM PV	PLANNED RESOURCES	TOTAL SUPPLY	NET CAPACITY POSITION
2024	490	411	14	67	492	2
2025	506	406	14	89	509	3
2026	524	473	14	211	698	174
2027	512	457	18	211	686	174
2028	504	441	22	235	698	194
2029	518	447	21	237	705	187
2030	533	240	19	284	543	10
2031	518	219	21	289	529	11
2032	504	198	23	300	522	17
2033	490	177	25	329	531	41
2034	477	156	27	353	536	59
2035	461	136	29	373	538	77

Table 25: 30 MMT Time Coincident Case Resource Data Template Reliability Need and Capacity Position (Effective MW)

	MARGINAL RELIABILITY NEED	CAPACITY UNDER CONTRACT	BTM PV	PLANNED RESOURCES	TOTAL SUPPLY	NET CAPACITY POSITION
2024	508	411	24	73	508	0
2025	526	405	27	94	526	0
2026	545	474	31	220	725	180
2027	525	457	28	216	702	176
2028	508	441	24	236	701	193
2029	500	430	22	232	683	183
2030	493	206	18	269	494	0
2031	488	192	20	275	488	0
2032	483	178	22	291	491	8
2033	478	164	25	321	510	32
2034	474	150	27	349	526	51
2035	468	136	29	373	538	71

g. High Electrification Planning

As described in Sections II.b.ii and III.a., the Climate Action Plan Alternative Portfolio reflects resource planning that would achieve San Francisco's building and transportation electrification goals, as described in the City's 2021 Climate Action Plan.[58] After review of the Additional Transportation Electrification (ATE) scenario developed by the CPUC for CAISO for study in the 2022-2023 Transmission Planning Process (TPP), and the higher Additional Achievable Fuel Substitution (AAFS) load scenarios considered in the 2021 IEPR, CleanPowerSF concludes that the demand projection associated with its Climate Action Plan Portfolio exceeds the high electrification demand increases from the ATE and AAFS scenarios. The sections below examine the incremental increases in energy usage and the associated additional renewable energy procurement needed between the Climate Action Plan Alternative Portfolio and the ATE and AAFS high electrification scenarios.

[58] San Francisco Climate Action Plan 2021, Page 41. Available at: https://sfenvironment.org/sites/default/files/cap_fulldocument_wappendix_web_220124.pdf [Accessed 10/13/2022]

High Transportation Electrification Review Approach

CleanPowerSF reviewed the ATE Scenario within the RESOLVE Scenario Tool[59] and used the CAISO-wide ATE results to calculate the percent modification to the sum of Managed Net Load[60] by electric vehicle load. CleanPowerSF also calculated the estimated energy increase in gigawatt-hours (GWh) due to the ATE that would be assigned to CleanPowerSF in the CPUC's ATE policy-driven sensitivity in the 2022-2023 TPP.[61] The first row of values in Table 26 below show the EV load modifier calculated within the Clean System Power calculator's 'IEPR CAISO Load Modifiers' tab. A review of the data behind the ATE Scenario within the RESOLVE Scenario Tool that was released on June 23rd provided the following load modifiers, or changes to CleanPowerSF's Managed Net Load caused by higher EV charging, shown in the table below.

Table 26: EV Load Modifiers

	2024	2026	2030	2035
Clean System Power Calculator EV Load Modifier	3.7%	5.1%	7.6%	10.9%
ATE Scenario EV Load Modifier	3.7%	5.1%	11.6%	26.4%

After applying the ATE-based EV load modifier to CleanPowerSF Managed Net Load, the resulting ATE Scenario's projected impact on CleanPowerSF load was compared to the transportation electrification projected under CleanPowerSF's Climate Action Plan Alternative Portfolio. The estimated demand increase, shown below in Table 27, indicate that the transportation electrification analysis in the Climate Action Plan Alternative Portfolio exceed the projected impact of the AET scenario in all years.

[59] See "CPUC IRP RESOLVE Scenario Tool 2022-06-23_CEC2021_loads.xlsb" with the Filing Requirements RESOLVE package at https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/zipped-files/resolve-public-release-2022-06-23-lse-plans-filing-requirements.zip.

[60] Managed Net Load referenced here includes behind-the-meter generation from PV resources, which were added to retail sales, consistent with the CPUC's methodology in the CSP.

[61] See 2022 IRP Narrative Template prompt for High Electrification Planning at page 14: https://www.cpuc.ca.gov/-/media/cpuc-website/divisions/energy-division/documents/integrated-resource-plan-and-long-term-procurement-plan-irp-ltpp/2022-irp-cycle-events-and-materials/narrative-template.docx [Accessed 10/27/2022]

Table 27: High Electrification Planning Transportation Electrification Load Increases (GWh)

Scenario		2024	2026	2030	2035
Transportation Electrification	CSP EV Energy (CSP-Assigned BTM PV)[62]	126.06	180.92	288.22	454.01
	CSP EV Energy (Custom BTM PV)	109.33	154.09	236.52	359.02
	ATE Estimated Energy (Custom BTM PV)	109.33	154.09	361.87	870.46
	Climate Action Plan Portfolio Energy (Custom BTM PV)	261.6	405.9	690.8	970.9

High Building Electrification Review Approach

CleanPowerSF reviewed the assumptions used for the High Electrification scenario(IEPR AAFS Scenario 4), [63] and the relationship between the percent AAFS Scenario 4 and the AAFS Load Modifiers provided in the CSP's IEPR Load Modifiers tab (representing AAFS Scenario 3) to calculate the projected increase to CleanPowerSF's annual energy demand.

The Clean System Power calculator assumes the AAFS load adjustments shown below in Table 28 that are applied to an LSE's Managed Net Load per the IEPR Mid Case (Scenario 3 AAEE, Scenario 3 AAFS) for the CAISO territory.

Table 28: AAFS Load Modifiers[64]

	2024	2026	2030	2035
CSP AAFS Load Modifier	0.416%	0.736%	1.391%	2.169%

The following Table provides CleanPowerSF's calculation of the difference between the CAISO Mid Case AAFS Scenario 3 and CAISO Mid Case AAFS Scenario 4.[65]

[62] Results are provided reflecting use of the BTM PV assignment to CleanPowerSF made within the Clean System Power calculator as well as CleanPowerSF's own BTM PV data; note that the Climate Action Plan Alternative Portfolio uses CleanPowerSF's own BTM PV data.
[63] See slide 10 in the linked presentation included in the Narrative Template's prompt which identified that the High Electrification scenario used the IEPR AAFS Scenario 4, Available at https://efiling.energy.ca.gov/GetDocument.aspx?tn=243222 [Accessed 10/13/2022]
[64] These are found in Row 48 of the IEPR CAISO Load Modifiers tab of the Clean System Power calculator.
[65] GWh totals are aggregated from CAISO Mid Case Hourly Demand files located at https://www.energy.ca.gov/data-reports/reports/integrated-energy-policy-report/2021-integrated-energy-policy-report/2021-1 [Accessed 10/13/2022].

Table 29: Comparison of Annual Energy Increase in CAISO Mid Case AAFS Scenario 3 and Mid Case AAFS Scenario 4

	CAISO Mid Case AAFS Scenario 3 Increase (GWh)	CAISO Mid Case AAFS Scenario 4 Increase (GWh)	% Increase Scenario 4 Over Scenario 3 (CSP Assumptions)
2022	273	280	102.7%
2023	595	621	104.4%
2024	961	1,009	105.0%
2025	1,360	1,433	105.3%
2026	1,753	1,860	106.1%
2027	2,166	2,308	106.5%
2028	2,596	2,772	106.8%
2029	3,047	3,258	106.9%
2030	3,520	3,759	106.8%
2031	4,010	4,275	106.6%
2032	4,517	4,805	106.4%
2033	5,003	5,312	106.2%
2034	5,466	5,793	106.0%
2035	5,897	6,238	105.8%

Augmentation of the AAFS Load Modifier to reflect the Scenario 4 projected load increases results in an estimated increase in load shown in row 3 of the Table below. One can see that Climate Action Plan Alternative Portfolio building electrification assumptions result in a higher load increase in years 2026, 2030 and 2035 and are 0.2 GWh below the Scenario 4 projections in 2024.

Table 30: High Electrification Planning Building Electrification Load Increases (GWh)

<table>
<tr><th colspan="2">Scenario</th><th>2024</th><th>2026</th><th>2030</th><th>2035</th></tr>
<tr><td rowspan="4">Building Electrification</td><td>CSP AAFS (CSP-Assigned BTM PV)</td><td>14.3</td><td>26.1</td><td>53.0</td><td>90.6</td></tr>
<tr><td>CSP AAFS (Custom BTM PV)</td><td>12.4</td><td>22.3</td><td>43.5</td><td>71.6</td></tr>
<tr><td>Estimated Scenario 4 Increase (Custom BTM PV)</td><td>13.0</td><td>23.6</td><td>46.5</td><td>75.8</td></tr>
<tr><td>Climate Action Plan Portfolio (Custom BTM PV)</td><td>12.8</td><td>107.1</td><td>295.7</td><td>574.5</td></tr>
</table>

The results of the transportation high electrification analysis and building high electrification analysis are aggregated below in Table 31. This shows that when the load increases for building electrification and transportation electrification are summed, CleanPowerSF's Climate Action Plan Alternative Portfolio exceeds the projected load increases calculated in the ATE Scenario and the AAFS Scenario 4. The full renewable resource generation required for building and transportation electrification, as estimated in the Climate Action Plan Alternative Portfolio, are shown in the final row of the table. Additionally, the incremental renewable resources beyond those of the Preferred

Conforming Portfolio that would be necessary to procure in order to meet the high electrification demand are outlined below in Table 32.

Table 31: Comparison of High Electrification Planning Load Projections and Climate Action Plan Portfolio, Aggregated (GWh)

SCENARIO		2024	2026	2030	2035
Transportation Electrification	CSP EV (CSP-Assigned BTM PV)	126.06	180.92	288.22	454.01
	CSP EV (Custom BTM PV)	109.33	154.09	236.52	359.02
	Estimated ATE (Custom BTM PV)	109.33	154.09	361.87	870.46
	SF Policy Goals Portfolio (Custom BTM PV)	261.6	405.9	690.8	970.9
Building Electrification	CSP AAFS (CSP-Assigned BTM PV)	14.3	26.1	53.0	90.6
	CSP AAFS (Custom BTM PV)	12.4	22.3	43.5	71.6
	Estimated Scenario 4 (Custom BTM PV)	13.0	23.6	46.5	75.8
	SF Policy Goals Portfolio (Custom BTM PV)	12.8	107.1	295.7	574.5
Aggregated	**Total Additional Electrification per ATE Scenario and Scenario 4**	**122.35**	**177.71**	**408.34**	**946.24**
	Total Additional Electrification Energy, Climate Action Plan Portfolio	**274.4**	**513.0**	**986.4**	**1,545.5**
	Total Additional Renewable Energy, Climate Action Plan Portfolio	**195.4**	**388.3**	**746.7**	**1,169.9**

Table 32: Additional Renewable Energy Resources for High Electrification

RESOURCE TYPE	MWS	ANNUAL GWH	2035 GHG TARGET	TRANSMISSION ZONE	SUBSTATION/BUS	ALTERNATIVE LOCATION	NOTE
Utility Scale Solar	100 MW	285.7	25 & 30 MMT	n/a	n/a	n/a	COD 1/1/2026
Geothermal	30 MW	239.7	25 & 30 MMT	n/a	n/a	n/a	COD 1/1/2030
Solar Hybrid	100 MW Solar, 50 MW Storage	285.6 (Solar)	25 & 30 MMT	n/a	n/a	n/a	COD 1/1/2027
	100 MW Solar, 50 MW Storage	285.6 (Solar)	25 & 30 MMT	n/a	n/a	n/a	COD 1/1/2033

h. Existing Resource Planning

In CleanPowerSF's 2020 IRP, 410 MW of existing resources were identified in the 38 MMT Preferred Conforming Portfolio, as outlined in Table 33 below. To limit overreliance on existing resources that were identified in the 2021 Preferred System Plan, CleanPowerSF's limited existing resource availability to its share of PG&E's Voluntary Allocation and Market Offer (VAMO) resources through the 2035 planning horizon in its 2022 IRP. [66] This constraint on existing resource availability is an appropriate proxy for existing resources available to CleanPowerSF since the VAMO resource pool represents an PG&E's excess contracted RPS capacity.

For its 2022 IRP, CleanPowerSF's Preferred Conforming Portfolio includes 60 MW of existing in-state hydro and 180 MW of blended renewable and GHG-free existing resources, which total 240 MW and make up less than 10% of the total portfolio capacity in 2035. CleanPowerSF does not anticipate significant challenges in procuring 240 MW of existing resources by 2035 and considers existing resources to be a component of a well-diversified portfolio. However, CleanPowerSF recognizes that

[66] *See* D.21-05-030 (authorizing a new VAMO process for RPS contracts subject to PCIA.)

competition, technology preferences, and resource availability are risks that should be considered in its planned procurement activities for existing resources.

Table 33: Summary of Existing Resources Identified in CleanPowerSF's Preferred Conforming Portfolio

TECHNOLOGY	2020 IRP PREFERRED CONFORMING PORTFOLIO	2022 IRP PREFERRED CONFORMING PORTFOLIO
Existing Geothermal	50 MW	n/a
Existing In-State Hydro	60 MW	60 MW
Blended Renewable and GHG-Free Existing Resources	300 MW	180 MW
Total	**410 MW**	**240 MW**

i. Hydro Generation Risk Management

CleanPowerSF has factored the risk of drought impacts on hydropower generation availability and the effects it may have on the emissions content of its portfolio. In 2021, hydro from California and the Pacific Northwest made up 38.8% of CleanPowerSF's Green product, but that number is expected to decline as CleanPowerSF continues to invest in new renewable energy capacity.

In the near-term, CleanPowerSF manages hydro generation risk by contracting for firm energy volumes from hydro facilities across the West. This approach ensures that CleanPowerSF will receive a minimum, firm volume of hydro generation. CleanPowerSF's suppliers regularly monitor weather forecasts and hydro generation conditions and notify CleanPowerSF in advance if they anticipate any shortfalls in hydro availability. To date, this has provided CleanPowerSF ample time to contract for any additional GHG-free supply that may be needed to meet its product content goals. To minimize the risk of regional droughts impacting CleanPowerSF's hydro portfolio, CleanPowerSF also strives to execute contracts with multiple suppliers and with a range of facilities across the Western United States.

In this IRP analysis, CleanPowerSF limited the quantity of available hydro it could procure to its proportional share of the California and Pacific Northwest future hydro generation used to model the 2021 PSP. CleanPowerSF's proportional share was determined to be 1.7% of generation available to the CAISO. As listed in the CPUC's total installed capacity list used to model the 2021 PSP, in-state hydro capacity was estimated to be 6,619 MW.[67] CleanPowerSF's share of this generation would be 112 MW. Acknowledging that this full capacity may not be available each year due to existing commitments and

[67] The total generator list is available on the CPUC's 2022 IRP modeling datasets repository: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials/unified-ra-and-irp-modeling-datasets-2022 [Accessed 9/22/2022]

drought, this share was risk adjusted down to 60 MW. In the RESOLVE model, a portion of Pacific Northwest (PNW) Hydro is available to CAISO as a directly scheduled import.[68] This represents 2,852 MW of capacity, of which CleanPowerSF's share is 48 MW. This was adjusted down to 40 MW to account for hydro generation risks.

The table below shows the total amount of hydro capacity that is not already under contract CleanPowerSF's Preferred Portfolio through the IRP planning horizon.

Table 34: Large Hydro Content in Preferred Portfolio

YEAR	TIME COINCIDENT PORTFOLIO (MW)	2021 PSP PROPORTIONAL SHARE (MW)
2023	100	160
2024	100	160
2025	100	160
2026	100	160
2027	100	160
2028	100	160
2029	100	160
2030	100	160
2031	100	160
2032	100	160
2033	100	160
2034	100	160
2035	100	160

As shown in Table 34, CleanPowerSF plans to procure less than its proportional share of hydro in all years. The Time Coincident portfolio includes California and PNW hydro through 2035 and on average, hydro makes up less than 14% of annual energy supply in the Time Coincident portfolio. Given that hydro represents a modest portion of the portfolios presented in this IRP, CleanPowerSF does not expect drought to have a significant impact on its portfolio costs or its ability to meet its emissions benchmark. However, CleanPowerSF will monitor hydrological conditions and hydroelectric resource availability and adjust its procurement approach accordingly.

[68] See 'Planned Installed Capacities' in the 2021 PSP RESOLVE Package available at: https://www.cpuc.ca.gov/industries-and-topics/electrical-energy/electric-power-procurement/long-term-procurement-planning/2022-irp-cycle-events-and-materials [Accessed 9/22/2022].

j. Long-Duration Storage Planning

CleanPowerSF IRP modeling shows that long-duration storage is a beneficial resource for CleanPowerSF's portfolio, it can contribute to California's reliability needs, and provide environmental benefits. Storage resources can charge during curtailment hours and deliver generation from intermittent renewables like solar and wind during hours when energy may be less available. CleanPowerSF is actively contracting for renewables paired with storage, and already has 289 MW of both paired and standalone energy storage under contract, 21.8 MW of which have an 8-hour discharge. CleanPowerSF's Preferred Conforming Portfolio contains an additional 350 MW of long-duration storage (8-12 hours), significantly exceeding CleanPowerSF's share of the existing procurement requirements.

The 90% time coincident constraint in CleanPowerSF's Preferred Portfolio favors the selection of more energy storage resources to provide the flexibility to shift generation to evening peak hours. Some risk considerations that CleanPowerSF weighs as it launches solicitations for battery storage include position in interconnection queue, project feasibility, deliverability, cost structure, project susceptibility to changes in State policy and legislation, among others.

k. Clean Firm Power Planning

CleanPowerSF IRP modeling shows that clean firm power is a beneficial resource for CleanPowerSF's portfolio as it can contribute to California's reliability needs and provide environmental benefits. Clean firm power resources deliver baseload generation that supplement intermittent renewables like solar and wind in CleanPowerSF's energy resource portfolio. While clean firm generation provides valuable baseload renewable energy, CleanPowerSF will continue to evaluate and balance the relatively high cost of clean firm resources, especially as opportunities to contract with emerging clean firm resource technologies develop.

CleanPowerSF is actively contracting for clean firm generation and has recently contracted for 19.3 MW of new geothermal capacity. The 2021 PSP calls for 1,160 MW of new geothermal by 2032 and CleanPowerSF's Time Coincident portfolio contains an additional 60 MW of new geothermal development, exceeding CleanPowerSF's pro-rata share of new geothermal needs and individual clean firm generation procurement obligation.

Through CC Power, CleanPowerSF contracted with other CCAs for a new 13 MW geothermal plant in Nevada and up to 125 MW of new geothermal capacity in Nevada and California. Almost all these resources are expected to be outside the CAISO balancing authority in northern Nevada or the Imperial Irrigation District and will require Maximum Import Capability (MIC) to be secured to deliver energy and capacity. MIC at northern Nevada delivery points is limited, and suppliers indicate that transmission capacity on NV Energy to southern Nevada is constrained. MIC expansion at northern Nevada delivery points such as Gonder, Summit, and Silver Peak would considerably decrease the risk of these projects not being able to provide clean firm capacity to the CAISO. Transmission projects that focus on better connecting the CAISO with northern Nevada resources, such as alleviating the Control substation constraint for the Oxbow line, could also de-risk northern Nevada as a source of clean firm resources and potentially reduce significant wheeling costs through other transmission providers.

The CC Power 125 MW geothermal portfolio also may contain a new resource inside CAISO at the Geysers. However, the Phase 1 results of its Cluster 14 study indicate that the project is dependent on the 500 kV Delevan network upgrade—which is expected to take 12 years to construct. This may result in substituting an import resource.

l. Out-of-State Wind Planning

The CPUC's 2021 Preferred System Plan included 1,500 MW of wind on new out-of-state transmission and CleanPowerSF acknowledges that new resource and transmission development may be needed to achieve the deeper statewide GHG reductions associated with the 25 MMT planning target. While out-of-state wind was not included in CleanPowerSF's modeled portfolios, it may become a more viable resource in the future. However, more analysis is needed to determine whether the state should prioritize investment in out-of-state wind transmission ahead of other resources.

m. Offshore Wind Planning

The CPUC's 2021 Preferred System Plan included 1,728 MW of offshore wind in 2035. While offshore wind was not selected as a candidate resource in CleanPowerSF's Conforming Portfolios, it may become a more viable resource in the future. However, more analysis is needed to achieve the planning goals required by Assembly Bill 525.

n. Transmission Planning

CleanPowerSF has executed additional contracted capacity since the IRP baseline[69] was established in January of 2020. This consists of:

- Adding 50 MW of new battery storage to the 100 MW Maverick Solar 6 project
- Adding 47 MW of new battery storage to the 62.5 MW Blythe Solar IV project,
- Paulsell Solar Energy Center (20 MW of new solar, 20 MW 3-hour storage),
- Aramis Solar (75 MW of new solar, 75 MW of new 4-hour storage),
- Tumbleweed (11.1 MW of new 8-hour storage under contract)
- Goal Line (10.8 MW of new 8-hour storage under contract)

CleanPowerSF has also executed additional capacity located in California and Nevada:

- Ormat Geothermal Portfolio (17.4 MW of new geothermal under contract)

[69] Administrative Law Judge Ruling Finalizing Baseline for Purposes of Procurement Required by Decision 19-11-016 available at: https://docs.cpuc.ca.gov/SearchRes.aspx?docformat=ALL&docid=323767159 [Accessed 10/7/2022]

- Fish Lake Geothermal (1.9 MW of new geothermal under contract)

These resources should be included in the baseline for modeling in the next CAISO Transmission Planning Process. These projects are hybrid solar plus storage, standalone storage, and geothermal resources. Maverick Solar 6 and Blythe Solar 6 are located in the Riverside and Palm Springs transmission zone. In addition to these two projects, CleanPowerSF has a number of resources under contract that have not yet reached their Commercial Operation Date. The CAISO interconnection queue position of these resources is summarized in Table 35.

Table 35: CleanPowerSF New Resource CAISO Interconnection Queue Positions

RESOURCE	CAPACITY (MW)	TRANSMISSION ZONE	CAISO INTERCONNECTION QUEUE POSITION
Aramis Solar	75 MW Solar/75 MW Storage	Solano	Cluster 10 - #1349
Paulsell Solar Energy Center	20 MW Solar/20 MW Storage	Los Banos	Cluster 10 - #1350
Tumbleweed	11.1 MW Battery Storage	Tehachapi	CAISO Queue 1217
Goal Line	10.8 MW Battery Storage	Greater Imperial	Cluster 14 - #1832

CleanPowerSF examined all of the planned resources identified in its Preferred Portfolio not yet under contract and has no strong preference on the location where these resources may be built. Apart from the standalone storage resources, CleanPowerSF's only locational requirement for the new generating resources is that they be able to directly deliver energy into the CAISO; these resources must also qualify for RPS compliance as PCC1 resources.

Although no specific new transmission lines or upgrades have been needed for the projects listed in Table 35 above, transmission upgrades triggered by other projects in the region may also provide benefits for CleanPowerSF's projects. CleanPowerSF does not plan to seek approval for any transmission upgrades and instead will continue to monitor the status of different transmission projects in the

CAISO's Transmission Planning Process as CleanPowerSF develops new resources for its Preferred Conforming Portfolio.

The Fish Lake geothermal project will connect to the Silver Peak substation in NV Energy territory. It is currently finalizing its interconnection agreement and expecting execution shortly. The developer does not anticipate any transmission-scale upgrades—just an upgrade to the Silver Peak substation. Fish Lake has secured transmission to a branch group, where CC Power members have secured 2023 MIC in preparation for a long-term MIC reservation. However, wheeling power to this branch group has resulted in higher costs that could be mitigated if MIC in northern Nevada became available.

The Ormat portfolio of geothermal projects are expected to mostly be import resources in northern NV Energy territory or the Imperial Irrigation District. Projects are at various stages of maturity in their subsurface characterization, permitting, and interconnection. The RDT contains a representation of what the portfolio might look like (entered as 7 projects with potential substations). Ormat has limited ability to deliver at southern Nevada import points, so MIC expansion will likely be needed at Summit, Gonder, and Silver Peak to deliver up to 125 MW. One potential CAISO resource in the portfolio (at the Geysers – queue position 1859) recently received Phase 1 results from its Cluster 14 study indicating that it is impacted by a network upgrade with a 12-year construction timeframe (Delevan 500kV)—which may require it be substituted in the geothermal portfolio for an import resource.

IV. Action Plan

a. Proposed Procurement Activities and Potential Barriers

CleanPowerSF's 2022 IRP modeling activities developed portfolios that could be feasibly implemented given current market conditions. This includes limiting new annual resource additions so they do not exceed what CleanPowerSF projects could be reasonably available in any given year.

CleanPowerSF only includes its pro rata share of existing renewable and large hydro resources in Conforming Portfolios. These modeling constraints resulted in a 2022 Preferred Conforming Portfolio that includes a balanced mix of short- and long-term commitments with a range of resource types and online dates. The procurement identified in the Preferred Conforming Portfolio will allow CleanPowerSF to meet its aggressive product content goals and contribute to its CPUC procurement obligations including those obligations associated with the Renewables Portfolio Standard, Resource Adequacy and IRP Procurement Track. The gradual rate of new resource additions will allow CleanPowerSF to plan for a reasonable procurement timeline and maintain the opportunity to capitalize on more favorable market conditions or emerging technologies in the outer years of the planning horizon.

Implementation of CleanPowerSF's Preferred Conforming Portfolio will require procurement efforts to be conducted for the following broad resource categories:

- New build renewable resources

- New storage resources, both paired and standalone
- Existing renewable resources
- Large hydroelectric resources

The table below summarizes the procurement strategies and tentative schedules for each resource category.

Table 36: CleanPowerSF Procurement Schedule

	TARGET RESOURCES	DESCRIPTION	TARGET INITIAL DELIVERY DATE(S)	SOLICITATION TIMING
Long-Term	New Build Utility Scale Renewables and Storage	New and existing renewable (solar, wind, geothermal) and storage	2026-2032	Annual
	New Build In-City Solar	Solar projects located on City-owned properties	2025	2nd Quarter 2023
Short-Term	Existing Renewables (VAMO)	Existing Renewables from IOUs' PCIA portfolios	2023, 2025, 2028	Once every RPS Compliance Period
	Existing Renewables and Large Hydro (Market)	Contracts with Existing Renewables and Large Hydro Resources	2023-2032	Ongoing

CleanPowerSF plans to issue annual Requests for Offers (RFOs) through the IRP planning horizon to contract for utility scale renewable and storage resources. Regular RFOs will allow CleanPowerSF to have access to the most up to date resource availability and pricing options. Annual RFOs will also allow CleanPowerSF to make adjustments to its procurement practices in response to current needs and market conditions to help minimize procurement risk and maximize ratepayer value.

CleanPowerSF is also committed to investing in local resources, defined as those within the nine Bay Area Counties. In response to stakeholder feedback on its IRP, including direction from the San Francisco Board of Supervisors, CleanPowerSF has been evaluating the feasibility of City-owned properties within San Francisco to support CleanPowerSF renewable energy projects. In 2020, CleanPowerSF released a Local Renewable Energy Report identifying the most suitable sites for development and has continued deeper analysis of potential sites since publishing the report.[70] Through this work, CleanPowerSF has selected two SFPUC-owned reservoirs as the sites with the highest near-term feasibility. The two reservoirs, University Mound North Basin and Sutro, represent approximately 6 MW of in-City solar

[70] See Local Renewable Energy Report for CleanPowerSF available at: https://static1.squarespace.com/static/5a79fded4c326db242490272/t/618aabff2fd9c54556ee7adb/1636477967793/CleanPowerSF+Local+RE+Report_March+2020.pdf [Accessed 10/25/2022]

capacity are included in the 2022 IRP Preferred Conforming portfolio. CleanPowerSF is in the process of developing technical specification and solicitation materials and plans to issue an RFO for this capacity by the second quarter of 2023 to bring the resources online by 2025.

In addition to long-term procurement, CleanPowerSF plans to conduct regular short-term procurement for renewable and large hydroelectric resources to maintain a balanced portfolio of resource types and contract lengths. CleanPowerSF plans to contract for these resources through the following mechanisms: PCIA Voluntary Allocations, PCIA Market Offers and short-term solicitations that are issued as needed. CleanPowerSF used its load ratio share of PG&E VAMO resources to inform the volume of existing renewable resources it could reasonably procure. CleanPowerSF has participated in the 2023-2024 Voluntary Allocation process and plans to participate in the IOUs' subsequent Market Offer processes. CleanPowerSF plans to continue participating in the VAMO at the start of future compliance periods to help close its short-term Preferred Conforming Portfolio's renewable energy position.

CleanPowerSF will also seek to contract with existing renewables and large hydroelectric resources through its own short-term solicitations. CleanPowerSF regularly tracks its RPS and large hydro positions relative to its annual IRP portfolio content targets and issues solicitations for these resources as needed. To minimize overreliance on existing resources, CleanPowerSF limited candidate hydro resources to its pro rata share of what was included in the 2020 Preferred System Plan. As discussed herein, existing renewable energy supply availability was limited to its share of PG&E's VAMO-eligible resources.

Along with meeting City and program goals, CleanPowerSF procurement activities aim to meet mandated procurement obligations, including those ordered in D.19-11-016 and D.21-06-035.

While resources such as out of state and offshore wind were not selected in CleanPowerSF's Preferred Conforming Portfolio, CleanPowerSF will continue to assess the suitability of these technologies for CleanPowerSF's portfolio and plans to accept bids from these resource types in future renewable energy solicitations. At the time of 2022 IRP modeling activities, these were not the most cost-effective resource types to meet CleanPowerSF program goals. However, price and technology updates may make these resources more competitive with other technology types in the future. If a bid is submitted for out of state or offshore wind in a renewable resource solicitation, the price and delivery characteristics will be evaluated to determine the bid value, portfolio fit, and project delivery risk against other proposals received. CleanPowerSF will also continue to monitor the development of these resource types and will plan to include them as candidate resource types in future IRPs.

i. Resources to meet D.19-11-016 procurement requirements

CleanPowerSF's D.19-11-016 procurement obligation is outlined in Table 37 below:

Table 37: CleanPowerSF's D.19-11-016 Procurement Obligation

	MINIMUM ONLINE BY 8/1/2021	MINIMUM ONLINE BY 8/1/2022	MINIMUM ONLINE BY 8/1/2023
MW NQC	28.5	42.8	57.0

CleanPowerSF has brought its full 57 MW share online as of June 2022, more than a prior to the Tranche 3 deadline. The entire obligation was met with renewable and storage resources. The details of the resources CleanPowerSF has used to meet its obligations are summarized in the table below.

Table 38: Summary of Resources Used for D.19-11-016 Compliance

RESOURCE NAME	RESOURCE TYPE	SEPTEMBER MW NQC	ONLINE DATE
San Pablo Raceway	Solar	14	August 2019
Blythe Solar IV	Solar	8.75	September 2020
Voyager IV Expansion	Wind	7.515	March 2021
Oasis Power Partners	Wind	9.045	October 2021
Maverick Solar 6	Solar	17.69	December 2021
	Storage		June 2022

ii. Resources to meet D.21-06-035 procurement requirements, including:

CleanPowerSF continues to make progress on its Mid-Term Reliability (MTR) obligations, which are outlined in the following table.

Table 39: CleanPowerSF's Mid-Term Reliability Procurement Obligations

	ONLINE BY 8/1/2023	ONLINE BY 6/1/2024	ONLINE BY 6/1/2025	ONLINE BY 6/1/2026 (LLT RESOURCES)	MINIMUM ZERO-EMITTING CAPACITY BY 2025
MW NQC	31	93	23	31	39

To date, CleanPowerSF has made significant progress towards meeting its MTR obligations, including its long-duration storage and firm clean resource requirements. CleanPowerSF entered into its long lead-time requirements as a member of the CC Power joint powers authority. Through CC Power, individual CCAs have been able to join efforts to contract for long lead time resources. CleanPowerSF can leverage its experiences contracting for these resources to procure larger projects or emerging technologies in the longer-term planning horizon.

In anticipation of the adoption of its 2022 Preferred Conforming Portfolio and to continue to make progress towards MTR procurement obligations, CleanPowerSF issued an RFO for new and existing renewable energy supplies and demand response capacity on September 21, 2022. This solicitation is accepting bids for projects with online dates through the end of 2028. Depending on the outcome of the solicitation, CleanPowerSF may emphasize specific resource types, such as firm clean renewables or standalone storage in future RFOs to support contracting with the resources identified in the Preferred Conforming Portfolio.

CleanPowerSF continues to procure to meet its MTR obligations and is prioritizing eligible resources, including demand response and renewables paired with long duration storage, in the solicitation discussed above. However, CleanPowerSF, like other LSEs, faces unprecedented and challenging market conditions that may impact its ability to comply with MTR deadlines as adopted by the California PUC and that may pose risks to the implementation of its Preferred Conforming Portfolio. These potential barriers include:

- Project Delays: Projects originally slated to come online mid-decade have faced a host of supply chain challenges related to the Covid-19 pandemic, global macroeconomic disruptions, and the Department of Commerce's circumvention investigation. These challenges are impacting project online dates as developers are struggling to meet key development milestones.
- Increased Costs: Recent inflation and the Department of Commerce's circumvention investigation have increased commodities, materials and financing costs which has made it challenging for developers to deliver projects at the prices in executed Power Purchase Agreements. For projects not yet under contract, CleanPowerSF is seeing average market prices that are significantly higher than they have been in the past.
- CASIO Interconnection and Deliverability Timelines: The CAISO Cluster 14 timeline has delayed the assessment of interconnection viability, identification of required network upgrades, and the awarding of deliverability for projects in the CAISO interconnection queue. This has created uncertainty regarding projects' viability, online dates, costs of upgrades, and their ability to count towards MTR compliance.
- Maximum Import Capability Uncertainty: Out of state projects that are important to meeting the CPUC's firm clean resource procurement targets may rely on obtaining long-term MIC or the success of MIC expansion requests to receive deliverability. The MIC allocation process cannot occur more than two years before project commercial operation date (COD) to secure long-term import allocations. This uncertainty creates risks regarding a resource's potential to deliver capacity into California and in turn, its ability to contribute to both CleanPowerSF's Preferred Conforming Portfolio and state mandated procurement requirements.

a. 1,000 MW of firm zero-emitting resource requirements

CleanPowerSF has contracted for up 19 MW of new geothermal capacity through its share of two executed contracts with CC Power. These resources were contracted as a result of a competitive solicitation completed by CC Power in early 2022.

The 13 MW Fish Lake geothermal project (CleanPowerSF's share is 1.9 MW) is expected to be commissioned in June 2024. As represented in the RDT, the project has high viability scores with subsurface characterization complete, a nearly finalized interconnection agreement, and partial financing. CC Power has also secured MIC at the project's delivery point sufficient to claim a long-term reservation.

The Ormat portfolio faces several risks. The contract included an illustrative facility list indicating a possible first COD in October 2024 and final COD in 2026. CleanPowerSF used the illustrative facility list to calibrate the representation of the Ormat portfolio in the RDT, which is likely to mostly rely on resources in northern NV Energy territory or the Imperial Irrigation District. Unlike Fish Lake, many of the projects in Ormat's portfolio are still dependent on subsurface characterization and need additional permitting. Importantly, although CC Power is hopeful the Ormat contract will provide 125 MW of capacity in total under the agreement, only 64 MW is guaranteed. Because specific projects are not yet identified, CC Power has also not been able to secure MIC—which is scarce in northern Nevada and may be difficult to obtain. Although Ormat can provide some transmission service to southern Nevada, MIC expansion at Gonder, Silver Peak, and Summit or transmission upgrades will likely be required to deliver the maximum capacity of the portfolio to the CAISO.

CC Power currently holds bi-weekly meetings with Ormat and will closely follow development progress in the Ormat portfolio. An update will be provided to the CPUC on timing and scope of the contract in the planned February 2023 regulatory filing. If it is determined unlikely that Ormat can deliver 125 MW by June 2028, CleanPowerSF will consider issuing a solicitation for replacement capacity independently or through CC Power in 2023.

CleanPowerSF will continue to explore opportunities to add to firm zero GHG-emitting resources through 2035, including the 60 MW of new geothermal development identified in CleanPowerSF's Preferred Portfolio that could be applied to CleanPowerSF's MTR procurement obligations, as needed. As mentioned above, CleanPowerSF issued an RFO for new and existing renewable energy supplies, in which projects eligible to count toward the CPUC's firm zero GHG-emitting resource procurement requirement may participate.

While geothermal resources provide valuable baseload renewable energy, CleanPowerSF will continue to evaluate and balance the relatively high cost of this resource within the portfolio, especially as opportunities to develop new geothermal resources emerge.

b. 1,000 MW of long-duration storage resource requirements

CleanPowerSF has existing long-duration storage resources in its portfolio and will explore opportunities to add additional long-duration storage to its portfolio through 2035, consistent with CleanPowerSF's Preferred Portfolio. It is possible that additional procurement of long-duration storage could be applied to satisfy CleanPowerSF's MTR procurement obligations or other, future procurement requirements. As mentioned above, CleanPowerSF issued an RFO for new and existing renewable energy supplies, in which projects eligible to count toward the CPUC's long-duration storage procurement requirement may participate.

While long-duration storage resources compliment intermittent renewable generation, CleanPowerSF will continue to optimize the procurement of storage resources to balance intermittent generation in its portfolio.

c. 2,500 MW of zero-emissions generation, generation paired with storage, or demand response resource requirements

As mentioned above, CleanPowerSF plans to issue annual RFOs through the IRP planning horizon to contract for zero-emission generation and storage resources. Annual RFOs will also allow CleanPowerSF to make adjustments to its procurement practices in response to current needs and market conditions to help minimize procurement risk and maximize ratepayer value while meeting MTR procurement obligations.

d. All other procurement requirements

All MTR procurement requirements are discussed above.

iii. Offshore wind

While offshore wind was not included in either of CleanPowerSF's Conforming Portfolios, it may become a more viable resource in the future. Due to its projected high capacity factor and favorable energy delivery profile, offshore wind is a potentially beneficial resource for California. CleanPowerSF will continue to monitor progress in offshore wind development in California and will continue to assess its suitability for CleanPowerSF's generation portfolio.

iv. Out-of-state wind

CleanPowerSF recognizes the potential role new out-of-state wind resources across the Western United States could play as new sources of renewable energy supply over the long-term planning horizon. However, CleanPowerSF's Preferred Conforming Portfolio did not include any new out-of-state wind resource development. While CleanPowerSF's procurement strategy does not prohibit procurement from new out-of-state wind resources, it prioritizes procurement from new local and in-state renewable projects.

Through its regular procurement activities, CleanPowerSF will continue to solicit new and existing renewable energy supply, inclusive of out-of-state wind resources, so that it is able to identify the most cost-effective resources for its ratepayers. CleanPowerSF will continue to monitor the out-of-state wind market and project development and regularly evaluate the cost-effectiveness and compatibility of these resources with its program goals. As the market evolves, out-of-state wind may become a more suitable resource for CleanPowerSF's portfolio in the future.

v. Other renewable energy not described above

CleanPowerSF has existing wind resources in its portfolio and will explore opportunities to add new wind resource capacity through 2035, including the 100 MW of new wind development identified in CleanPowerSF's Preferred Portfolio. As mentioned above, CleanPowerSF issued an RFO for new and existing renewable energy supplies, in which wind projects would meet the RFO's eligibility requirements.

While wind is an intermittent renewable resource, CleanPowerSF will continue to optimize the procurement of baseload and storage resources to balance intermittent generation in its portfolio.

vi. Other energy storage not described above

CleanPowerSF has no additional information in response to sub-section vi.

vii. Other demand response not described above

CleanPowerSF has no additional information in response to sub-section vii.

viii. Other energy efficiency not described above

CleanPowerSF has no additional information in response to sub-section viii.

ix. Other distributed generation not described above

CleanPowerSF has no additional information in response to sub-section ix.

x. Transportation electrification, including any investments above and beyond what is included in Integrated Energy Policy Report (IEPR)

The building electrification load requirements and the transportation electrification load requirements of the Preferred Conforming Portfolio represent roughly 35% of the electrification load requirements of the Climate Action Plan Alternative Portfolio. As discussed in Section II, CleanPowerSF has invested in developing building and transportation models to project the load requirements of the City's goals based on San Francisco's specific footprint and aggressive goals and targets – goals and targets that push required load projections beyond those of the High Electrification Planning reviewed in Section III.f.

In Section III.f above, CleanPowerSF identifies additional generation resources needed to meet the anticipated increase in load resulting from three high electrification scenarios. Those resources include 100 MW utility-scale solar, 30 MW geothermal, and 150 MW solar paired with storage (100 MW solar, 50 MW storage). While these resources are incremental to those identified in the Preferred Conforming Portfolio, the products that CleanPowerSF seeks in its solicitations for new resources encourages bids for projects that share the same generation attributes described in the High Electrification Planning section above that could support the projected load increases for higher levels of electrification.

The results of these analyses will inform CleanPowerSF's regular procurement for RPS-eligible renewable and GHG-free resources. CleanPowerSF will be using these projections, as well as monitoring consumption data to assess the ongoing impact of electrification, ahead of scheduled procurements to inform resource types, capacities, and total generation sought.

The increased load requirements due to building and transportation electrification are subjects of ongoing study by CleanPowerSF and the SFPUC. Studies to date have shown that San Francisco is an outlier in its building energy use and electrification profiles (and may also be in transportation electrification due its high-density and high-commuter usage), driving CleanPowerSF interest in utilizing local data to inform procurement. CleanPowerSF will continue to monitor changes to total consumption and hourly demand shapes across rate classes to continually improve electrification demand projections.

CleanPowerSF will explore new demand response programs, technology demonstrations, electrification-focused incentives, targeted technical assistance for low-income owners and tenants, and other resources and incentives to ensure building electrification is appropriately incentivized and to mitigate burdens on low-income ratepayers.

xi. Building electrification, including any investments above and beyond what is included in Integrated Energy Policy Report (IEPR)

Building electrification is addressed in the 'Transportation electrification, including any investments above and beyond what is included in Integrated Energy Policy Report (IEPR)' section above.

xii. Other

The generation technologies identified in CleanPowerSF's Preferred Conforming Portfolios have been addressed in the preceding sections. CleanPowerSF is not planning any procurement activities for generation technologies that are not addressed in the preceding sections.

b. Disadvantaged Communities

CleanPowerSF is committed to minimizing – and eliminating – any harmful air emissions associated with its electricity supply portfolio, especially from plants located within the California's Disadvantaged Communities. CleanPowerSF's 25 MMT and 30 MMT Preferred Portfolios do not include specified purchases from fossil fueled resources, and the Time Coincident Case reduces its reliance on system power. The new build associated with the Time Coincident Portfolio includes a significant amount of new battery storage, which will help shape variable renewable generation to customers' usage and CAISO system need, minimizing CleanPowerSF's use of fossil-fueled resources to serve load.

As it begins to implement its Preferred Portfolio, CleanPowerSF will conduct outreach and seek input from Disadvantaged Communities that could be impacted by planned procurement in or near their communities. CleanPowerSF conducted local stakeholder engagement throughout its IRP process, including a series of webinars on the IRP process, and invited a large number of community organizations – and all of its customers – to participate. CleanPowerSF also posted its IRP modeling results and the proposed recommended Preferred Portfolio for public comment for approximately 3 weeks.[71] CleanPowerSF will continue to engage communities that may be impacted by its power supply planning and procurement activities.

In accordance with the SFPUC's Community Benefits policy,[72] CleanPowerSF has sought to include Community Benefits Agreements as part of its long-term renewable energy contracts. CleanPowerSF, as a program of the SFPUC, encourages responses to competitive solicitations for renewable energy supply valued at $5 million or more to include social impact commitments to benefit communities directly affected by the construction and operation of projects.[73] The SFPUC was the first public utility in the nation to adopt community benefits and environmental justice policies, and through new long-term renewable commitments, CleanPowerSF aims to continue contributing to investments in workforce development, education, environmental justice, neighborhood revitalization, and the arts in communities impacted by its activities.[74]

c. Commission Direction of Actions

The CPUC does not authorize CleanPowerSF's spending, programmatic goals, budgets or procurement. However, the CPUC procurement orders and potential future programmatic approaches to procurement will have significant impacts on procurement by LSEs, including CleanPowerSF.

With respect to the D.21-06-035 procurement order, CleanPowerSF requests that the CPUC provide more certainty around deliverability issues, especially as it relates to the MIC expansion process. As discussed in section III.k. above, the current process provides a significant barrier to procurement of firm clean power, especially for resources located out-of-state, as LSEs must procure in advance of securing import allocation rights.

CleanPowerSF also requests that in future IRPs CPUC staff develops a process where LSEs can use their own forecasts of load modifiers, including BTM PV, in Conforming Portfolios assumptions. For this IRP, the discrepancy between CPUC and CleanPowerSF BTM PV forecasts were significant. This will result in modeling results for CleanPowerSF's Conforming Portfolios that do not accurately or appropriately reflect CleanPowerSF's net load. While CleanPowerSF took steps to use custom load shapes to reduce

---

[71] The CleanPowerSF IRP stakeholder engagement materials and public comments received will be made available at: www.cleanpowersf.org/resourceplan [Accessed 10/31/2022]

[72] SFPUC Commission Resolution No. 11-0008 affirming the Community Benefits Policy is available at: https://sfpuc.org/sites/default/files/about-us/policies-reports/CommunityBenefits%20Policy_JAN2011.pdf [Accessed 10/12/22]

[73] See Social Impact Partnerships in Contracts Process Overview at: https://sfpuc.org/sites/default/files/construction-and-contracts/Social%20Impact%20Program%20Information_2021.pdf [Accessed 10/12/2022]

[74] More information on the SFPUC's Community Benefits program is available at: https://sfpuc.org/about-us/policies-plans/community-benefits-policy [Accessed 10/12/2022]

the impact of the different BTM PV forecasts,[75] it would be better for IRPs to be based on the best information possible.

V. Lessons Learned

CleanPowerSF thanks Energy Division staff for all its efforts to administer an efficient and effective process in this IRP cycle. CleanPowerSF appreciates the frequent communication by Energy Division staff and their responsiveness to questions and comments. CleanPowerSF offers the following suggestion to improve the process in the future:

Set a firm schedule that gives LSEs sufficient time to develop a comprehensive IRP. CleanPowerSF has repeatedly advocated for the CPUC to set, and stick to, a reasonable schedule which would allow LSEs sufficient time to prepare thorough and well detailed portfolios and plans.[76] CleanPowerSF would like to start preparing its IRP filing early. However, several critical inputs and filing requirements remained in flux for the 2022 IRP until the end of July 2022. Most importantly, finalized ELCC values were not available until July 29 which precluded LSEs from finalizing their model until August 2022, which was quite late given the IRP due date of November 1st. These delays occurred despite the schedule adopted in D.22-02-004 setting June 15, 2022 as the date by which the filing requirements would be finalized.

As CleanPowerSF recommended in the last 2020 IRP narrative, the CPUC should adopt a date by which all requirements and templates must be finalized and adjust IRP due dates if there are delays. As previously recommended, this period should be at least six months.[77] This would allow CCAs sufficient time to conduct and refine analysis, conduct public outreach, and obtain approval from their governing Commissions or Boards. If delays occur past this date, then the IRP due date should be extended to ensure LSEs have sufficient time to conduct their planning process and obtain approval from their governing bodies. CleanPowerSF requests that in future IRP cycles, the CPUC provide LSEs at least 6 months from the date when all filing requirements and templates are finalized to conduct their IRP analysis, perform outreach and engage with interested parties, and obtain approval from their governing bodies.

---

[75] See section III.C. *supra*.

[76] See e.g., Opening Comments of the City and County of San Francisco on the Administrative Law Judge's Ruling Establishing Process for Finalizing Load Forecasts and Greenhouse Gas Emissions Benchmarks for 2022 Integrated Resources Plan Filings, Opening Comments of the City and County of San Francisco on the Proposed Decision Adoption 2021 Preferred System Plan, and Section V of CleanPowerSF 2020 Integrated Resource Plan.

[77] CleanPowerSF 2020 Integrated Resources Plan Compliance Filing (Public Filing). https://sfpuc.sharefile.com/share/view/s61300b4056124fcda409799fd243d245 [accessed 10/12/2022].

Glossary of Terms

Alternative Portfolio: *LSEs are permitted to submit "Alternative Portfolios" developed from scenarios using different assumptions from those used in the Preferred System Plan with updates. Any deviations from the "Conforming Portfolio" must be explained and justified.*

Approve (Plan)*: the CPUC's obligation to approve an LSE's integrated resource plan derives from Public Utilities Code Section 454.52(b)(2) and the procurement planning process described in Public Utilities Code Section 454.5, in addition to the CPUC obligation to ensure safe and reliable service at just and reasonable rates under Public Utilities Code Section 451.*

Balancing Authority Area (CAISO): *the collection of generation, transmission, and loads within the metered boundaries of the Balancing Authority. The Balancing Authority maintains load-resource balance within this area.*

Baseline resources: *Those resources assumed to be fixed as a capacity expansion model input, as opposed to Candidate resources, which are selected by the model and are incremental to the Baseline. Baseline resources are existing (already online) or owned or contracted to come online within the planning horizon. Existing resources with announced retirements are excluded from the Baseline for the applicable years. Being "contracted" refers to a resource holding signed contract/s with an LSE/s for much of its energy and capacity, as applicable, for a significant portion of its useful life. The contracts refer to those approved by the CPUC and/or the LSE's governing board, as applicable. These criteria indicate the resource is relatively certain to come online. Baseline resources that are not online at the time of modeling may have a failure rate applied to their nameplate capacity to allow for the risk of them failing to come online.*

Candidate resource: *those resources, such as renewables, energy storage, natural gas generation, and demand response, available for selection in IRP capacity expansion modeling, incremental to the Baseline resources.*

Capacity Expansion Model: *a capacity expansion model is a computer model that simulates generation and transmission investment to meet forecast electric load over many years, usually with the objective of minimizing the total cost of owning and operating the electrical system. Capacity expansion models can also be configured to only allow solutions that meet specific requirements, such as providing a minimum amount of capacity to ensure the reliability of the system or maintaining greenhouse gas emissions below an established level.*

Certify (a Community Choice Aggregator Plan)*: Public Utilities Code 454.52(b)(3) requires the CPUC to certify the integrated resource plans of CCAs. "Certify" requires a formal act of the Commission to determine that the CCA's Plan complies with the requirements of the statute and the process established via Public Utilities Code 454.51(a). In addition, the Commission must review the CCA Plans to determine any potential impacts on public utility bundled customers under Public Utilities Code Sections 451 and 454, among others.*

Clean System Power (CSP) methodology*: the methodology used to estimate GHG and criteria pollutant emissions associated with an LSE's Portfolio based on how the LSE will expect to rely on system power on an hourly basis.*

Community Choice Aggregator*: a governmental entity formed by a city or county to procure electricity for its residents, businesses, and municipal facilities.*

***Conforming Portfolio**: the LSE portfolio that conforms to IRP Planning Standards, the 2030 LSE-specific GHG Emissions Benchmark, use of the LSE's assigned load forecast, use of inputs and assumptions matching those used in developing the Reference System Portfolio, as well as other IRP requirements including the filing of a complete Narrative Template, a Resource Data Template and Clean System Power Calculator*.

***Effective Load Carrying Capacity**: a percentage that expresses how well a resource is able avoid loss-of-load events (considering availability and use limitations). The percentage is relative to a reference resource, for example a resource that is always available with no use limitations. It is calculated via probabilistic reliability modeling, and yields a single percentage value for a given resource or grouping of resources.*

***Effective Megawatts (MW):** perfect capacity equivalent MW, such as the MW calculated by applying an ELCC % multiplier to nameplate MW.*

***Electric Service Provider**: an entity that offers electric service to a retail or end-use customer, but which does not fall within the definition of an electrical corporation under Public Utilities Code Section 218.*

***Filing Entity**: an entity required by statute to file an integrated resource plan with CPUC.*

***Future**: a set of assumptions about future conditions, such as load or gas prices.*

***GHG Benchmark (or LSE-specific 2030 GHG Benchmark)**: the mass-based GHG emission planning targets calculated by staff for each LSE based on the methodology established by the California Air Resources Board and required for use in LSE Portfolio development in IRP.*

***GHG Planning Price:** the systemwide marginal GHG abatement cost associated with achieving a specific electric sector 2030 GHG planning target.*

***Integrated Resources Planning Standards (Planning Standards)**: the set of CPUC IRP rules, guidelines, formulas and metrics that LSEs must include in their LSE Plans.*

***Integrated Resource Planning (IRP) process**: integrated resource planning process; the repeating cycle through which integrated resource plans are prepared, submitted, and reviewed by the CPUC*

***Long term**: more than 5 years unless otherwise specified.*

***Load Serving Entity**: an electrical corporation, electric service provider, community choice aggregator, or electric cooperative.*

***Load Serving Entity (LSE) Plan**: an LSE's integrated resource plan; the full set of documents and information submitted by an LSE to the CPUC as part of the IRP process.*

***Load Serving Entity (LSE) Portfolio**: a set of supply- and/or demand-side resources with certain attributes that together serve the LSE's assigned load over the IRP planning horizon.*

***Loss of Load Expectation (LOLE):** a metric that quantifies the expected frequency of loss-of-load events per year. Loss-of-load is any instance where available generating capacity is insufficient to serve electric demand. If one or more instances of loss-of-load occurring within the same day regardless of duration are counted as one loss-of-load event, then the LOLE metric can be compared to a reference point such as the industry probabilistic reliability standard of "one expected day in 10 years," i.e. an LOLE of 0.1.*

Maximum Import Capability: a California ISO metric that represents a quantity in MWs of imports determined by the CAISO to be simultaneously deliverable to the aggregate of load in the ISO's Balancing Authority (BAA) Area and thus eligible for use in the Resource Adequacy process. The California ISO assess a MIC MW value for each intertie into the ISO's BAA and allocated yearly to the LSEs. A LSE's RA import showings are limited to its share of the MIC at each intertie.

Net Qualifying Capacity (NQC): *Qualifying Capacity reduced, as applicable, based on: (1) testing and verification; (2) application of performance criteria; and (3) deliverability restrictions. The Net Qualifying Capacity determination shall be made by the California ISO pursuant to the provisions of this California ISO Tariff and the applicable Business Practice Manual.*

Non-modeled costs*: embedded fixed costs in today's energy system (e.g., existing distribution revenue requirement, existing transmission revenue requirement, and energy efficiency program cost).*

Nonstandard LSE Plan*: type of integrated resource plan that an LSE may be eligible to file if it serves load outside the CAISO balancing authority area.*

Optimization*: an exercise undertaken in the CPUC's Integrated Resource Planning (IRP) process using a capacity expansion model to identify a least-cost portfolio of electricity resources for meeting specific policy constraints, such as GHG reduction or RPS targets, while maintaining reliability given a set of assumptions about the future. Optimization in IRP considers resources assumed to be online over the planning horizon (baseline resources), some of which the model may choose not to retain, and additional resources (candidate resources) that the model is able to select to meet future grid needs.*

Planned resource: *any resource included in an LSE portfolio, whether already online or not, that is yet to be procured. Relating this to capacity expansion modeling terms, planned resources can be baseline resources (needing contract renewal, or currently owned/contracted by another LSE), candidate resources, or possibly resources that were not considered by the modeling, e.g., due to the passage of time between the modeling taking place and LSEs developing their plans. Planned resources can be specific (e.g., with a CAISO ID) or generic, with only the type, size and some geographic information identified.*

Qualifying capacity*: the maximum amount of Resource Adequacy Benefits a generating facility could provide before an assessment of its net qualifying capacity.*

Preferred Conforming Portfolio*: the conforming portfolio preferred by an LSE as the most suitable to its own needs; submitted to CPUC for review as one element of the LSE's overall IRP plan.*

Preferred System Plan: *the Commission's integrated resource plan composed of both the aggregation of LSE portfolios (i.e., Preferred System Portfolio) and the set of actions necessary to implement that portfolio (i.e., Preferred System Action Plan).*

Preferred System Portfolio: *the combined portfolios of individual LSEs within the CAISO, aggregated, reviewed and possibly modified by Commission staff as a proposal to the Commission, and adopted by the Commission as most responsive to statutory requirements per Pub. Util. Code 454.51; part of the Preferred System Plan.*

Short term*: 1 to 3 years (unless otherwise specified).*

Staff*: CPUC Energy Division staff (unless otherwise specified).*

Standard LSE Plan*: type of integrated resource plan that an LSE is required to file if it serves load within the CAISO balancing authority area (unless the LSE demonstrates exemption from the IRP process).*

Transmission Planning Process (TPP)*: annual process conducted by the California Independent System Operator (CAISO) to identify potential transmission system limitations and areas that need reinforcements over a 10-year horizon.*

VERIFICATION

I, Michael Hyams, am authorized to make this Verification on behalf of CleanPowerSF. I declare under penalty of perjury that the statements in the foregoing 2022 CleanPowerSF Integrated Resource Plan Compliance Filing are true of my own knowledge, except as to matters which are therein stated on information or belief, and as to those matters I believe them to be true.

Executed October 31, 2022, at San Anselmo, California.

By: ______________________
Michael A. Hyams
Director
CleanPowerSF
San Francisco Public Utilities Commission
525 Golden Gate Avenue, 7th Floor
San Francisco, CA 94102
Email: mhyams@sfwater.org

Appendix A

25 MMT Preferred Conforming Portfolio
Resource Data Template

(Public, Redacted)

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF

Appendix B

30 MMT Preferred Conforming Portfolio
Resource Data Template

(Public, Redacted)

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF

Appendix C

25 MMT Base Case Conforming Portfolio
Resource Data Template

(Public, Redacted)

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF

Appendix D

25 MMT Preferred Conforming Portfolio Clean System Power Calculator

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF

Appendix E

30 MMT Preferred Conforming Portfolio Clean System Power Calculator

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF

Appendix F

25 MMT Base Case Portfolio Clean System Power Calculator

Posted at www.cleanpowersf.org/resourceplan

San Francisco
Water
Power
Sewer

Services of the San Francisco
Public Utilities Commission

CleanPowerSF

Appendix G

2021 IEPR Load Modifiers

(Public, Redacted)

Posted at www.cleanpowersf.org/resourceplan

San Francisco Water Power Sewer

Services of the San Francisco Public Utilities Commission

CleanPowerSF